



PROXMOX MAIL GATEWAY ADMINISTRATION GUIDE

RELEASE 6.1



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Proxmox Server Solutions GmbH
www.proxmox.com

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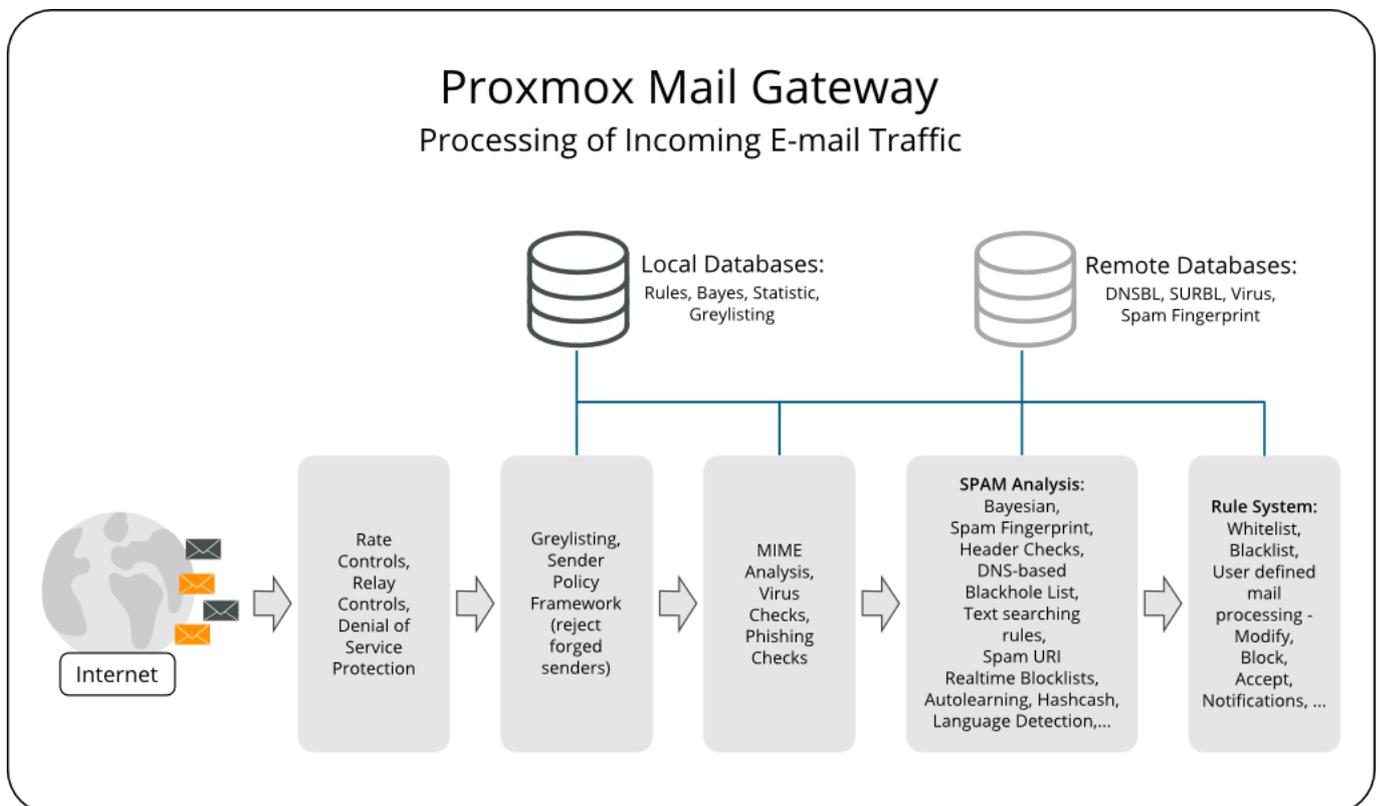
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Chapter 1

Introduction

1.1 What is Proxmox Mail Gateway?

E-mail security begins at the gateway by controlling all incoming and outgoing e-mail messages. Proxmox Mail Gateway addresses the full spectrum of unwanted e-mail traffic, focusing spam and virus detection. Proxmox Mail Gateway provides a powerful and affordable server solution to eliminate spam, viruses and blocking undesirable content from your e-mail system. All products are self-installing and can be used without deep knowledge of Linux.



1.2 Features

1.2.1 Spam detection

Proxmox Mail Gateway uses a wide variety of local and network tests to identify spam mail. Here is a short list of used filtering methods:

Receiver Verification

Many of the junk messages reaching your network are emails to non-existent users. Proxmox Mail Gateway detects these emails on SMTP level, which means before they are transferred to your networks. This reduces the traffic to be analyzed for spam and viruses up to 90% and reduces the working load on your mail servers and scanners.

Sender policy framework (SPF)

Sender Policy Framework (SPF) is an open standard for validating emails and to prevent sender IP address forgery. SPF allows the administrator of an Internet domain to specify which computers are authorized to send emails with a given domain by creating a specific SPF record in the Domain Name System (DNS).

DNS-based Blackhole List

A DNS-based Blackhole List (DNSBL) is a means by which an Internet site may publish a list of IP addresses, in a format which can be easily queried by computer programs on the internet. The technology is built on top of the Domain Name System. DNSBLs are used to publish lists of addresses linked to spamming.

SMTP Whitelist

Exclude senders from SMTP blocking. To prevent all SMTP checks (Greylisting, Receiver Verification, SPF and RBL) and accept all e-mails for the analysis in the filter rule system, you can add the following to this list: Domains (Sender/Receiver), Mail address (Sender/Receiver), Regular Expression (Sender/Receiver), IP address (Sender), IP network (Sender)

Bayesian Filter - Automatically trained statistical filters

Some particular words have a higher probability of occurring in spam emails rather than in legitimate emails. By being trained to recognize those words, the Bayesian checks every email and adjusts the probabilities of it being a spam word or not in its database. This is done automatically.

Black- and Whitelists

Black- and Whitelists are an access control mechanism to accept, block, or quarantine emails to recipients. This allows you to tune the rule-system by applying different objects like domains, email address, regular expression, IP Network, LDAP Group, and others.

Autolearning algorithm

Proxmox Mail Gateway gathers statistical information about spam emails. This information is used by an autolearning algorithm, so the system becomes smarter over time.

Spam Uri Realtime BlockList (SURBL)

SURBLs are used to detect spam based on message body URIs (usually web sites). This makes them

different from most other Real-time Blocklists, because SURBLs are not used to block spam senders. SURBLs allow you to block messages that have spam hosts which are mentioned in message bodies.

Greylisting

Greylisting an email from a sender your system does not recognize, means, that it will be temporarily rejected. Since temporary failures are built into the RFC specifications for mail delivery, a legitimate server will try to resend the email later on. This is an effective method because spammers do not queue and reattempt mail delivery as is normal for a regular Mail Transport Agent.

Greylisting can reduce e-mail traffic up to 50%. A greylisted email never reaches your mail server and thus your mail server will not send useless "Non Delivery Reports" to spammers.

SMTP Protocol Tests

Postfix is able to do some sophisticated SMTP protocol tests (see `man postscreen`). Most spam is sent out by zombies (malware on compromised end-user computers), and those zombies often try to maximize the amount of mails delivered. In order to do that, many of them violates the SMTP protocol specification and can thus be detected by these tests.

Before and After Queue Filtering

Proxmox Mail Gateway can be configured to either accept the mail, by sending a response of *250 OK*, and scan it afterwards, or alternatively inspect the mail directly after it has the content and respond with a reject *554* if the mail is blocked by the rule system. These options are known as After Queue and Before Queue filtering respectively (see [Before and After Queue Scanning](#) Section 4.5.5).

Configurable NDR policy

In certain environments it can be unacceptable to discard an email, without informing the sender about that decision. You can decide whether you want to inform the senders of blocked emails or not.

1.2.2 Virus detection

Proxmox Mail Gateway integrates **ClamAV®**, which is an open-source (GPL) antivirus engine designed for detecting Trojans, viruses, malware and other malicious threats.

It provides a high performance mutli-threaded scanning daemon, command line utilities for on demand file scanning, and an intelligent tool for automatic signature updates.

1.2.3 Object-Oriented Rule System

The object-oriented rule system enables custom rules for your domains. It's an easy but very powerful way to define filter rules by user, domains, time frame, content type and resulting action. Proxmox Mail Gateway offers a lot of powerful objects to configure your own custom system.

WHO - objects

Who is the sender or receiver of the e-mail?

WHAT - objects

What is in the e-mail?

WHEN - objects

When is the e-mail received by Proxmox Mail Gateway?

ACTIONS - objects

Defines the final actions.

Every rule has five categories FROM, TO, WHEN, WHAT and ACTION. Every of these categories can contain several objects and a direction (in, out or both).

Options range from simple spam and virus filter setups to sophisticated, highly customized configurations blocking certain types of e-mails and generating notifications.

1.2.4 Spam Quarantine

Identified Spam mails can be stored to the user accessible Spam quarantine. Thus users can view and manage there Spam mails by themselves.

1.2.5 Tracking and Logging

The innovative Proxmox Message Tracking Center tracks and summarizes all available logs. With the web-based and user friendly management interface, the IT admins can easily overview and control all functions from a single screen.

The Message Tracking Center is very fast and powerful, tested on Proxmox Mail Gateway sites processing over a million emails per day. All different log files from the last 7 days can be queried and the results are summarized by an intelligent algorithm.

- Arrival of the email
- Proxmox filtering processing with results
- Internal queue to your email server
- Status of final delivery

1.2.6 DKIM Signing

Proxmox Mail Gateway offers the possibility to optionally sign outgoing emails with [DKIM](#) Section [4.5.9](#).

1.2.7 High Availability with Proxmox HA Cluster

To provide a 100% secure email system for your business, we developed Proxmox High Availability (HA) Cluster. The Proxmox HA Cluster uses a unique application level clustering scheme, which provides extremely good performance. Fast set-up within minutes and a simple, intuitive management keep resource needs low. After temporary failures, nodes automatically reintegrate without any operator interaction.

1.2.8 LDAP integration

It is possible to query user and group data from LDAP servers. This may be used to build special filter rules, or just to provide authentication services for the Spam quarantine GUI.

1.2.9 Fetchmail integration

Proxmox Mail Gateway allows you to fetch mail from other IMAP or POP3 servers.

1.2.10 Flexible User Management

The administration interface uses a role based access control scheme, using the following roles:

Superuser

This role is allowed to do everything (reserved for user *root*).

Administrator

Full access to mail filter setup, but not allowed to change network setup.

Quarantine Manager

Is able to view and manage the Spam Quarantine.

Auditor

Has read-only access to the whole configuration, can access logs and view statistics.

1.3 Your benefit with Proxmox Mail Gateway

- Open source software
 - No vendor lock-in
 - Linux kernel
 - Fast installation and easy-to-use
 - Web-based management interface
 - REST API
 - Huge active community
 - Low administration costs and simple deployment
-

1.4 Getting Help

1.4.1 Community Support Forum

Proxmox Mail Gateway itself is fully open source, so we always encourage our users to discuss and share their knowledge using the [Proxmox Community Forum](#). The forum is fully moderated by the Proxmox support team, and has a quite large user base around the whole world. Needless to say that such a large forum is a great place to get information.

1.4.2 Commercial Support

Proxmox Server Solutions GmbH also offers commercial [Proxmox Mail Gateway Subscription Service Plans](#). System Administrators with a standard subscription plan can access a dedicated support portal with guaranteed response time, where Proxmox Mail Gateway developers help them should an issue appear. Please contact the [Proxmox sales team](#) for more information or volume discounts.

1.4.3 Bug Tracker

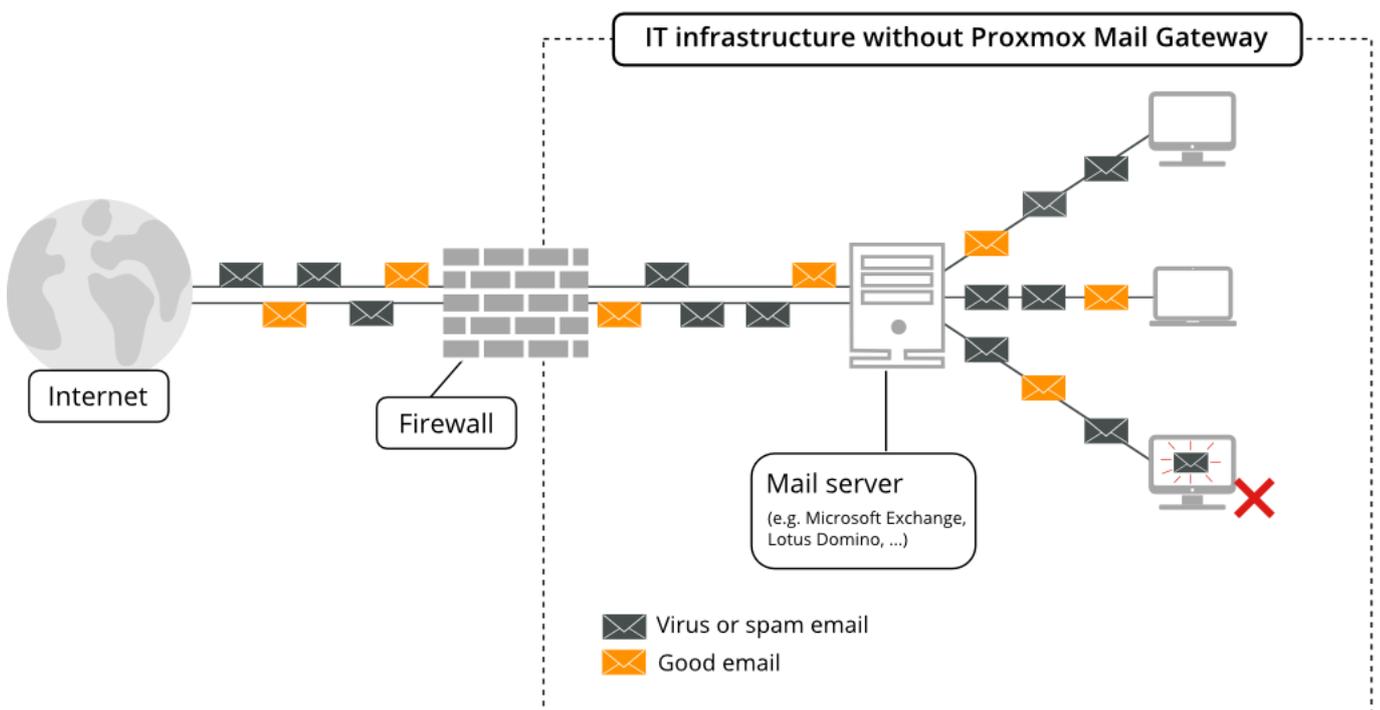
We also run a public bug tracker at <https://bugzilla.proxmox.com>. If you ever detect a bug, you can file an bug entry there. This makes it easy to track the bug status, and you will get notified as soon as the bug is fixed.

Chapter 2

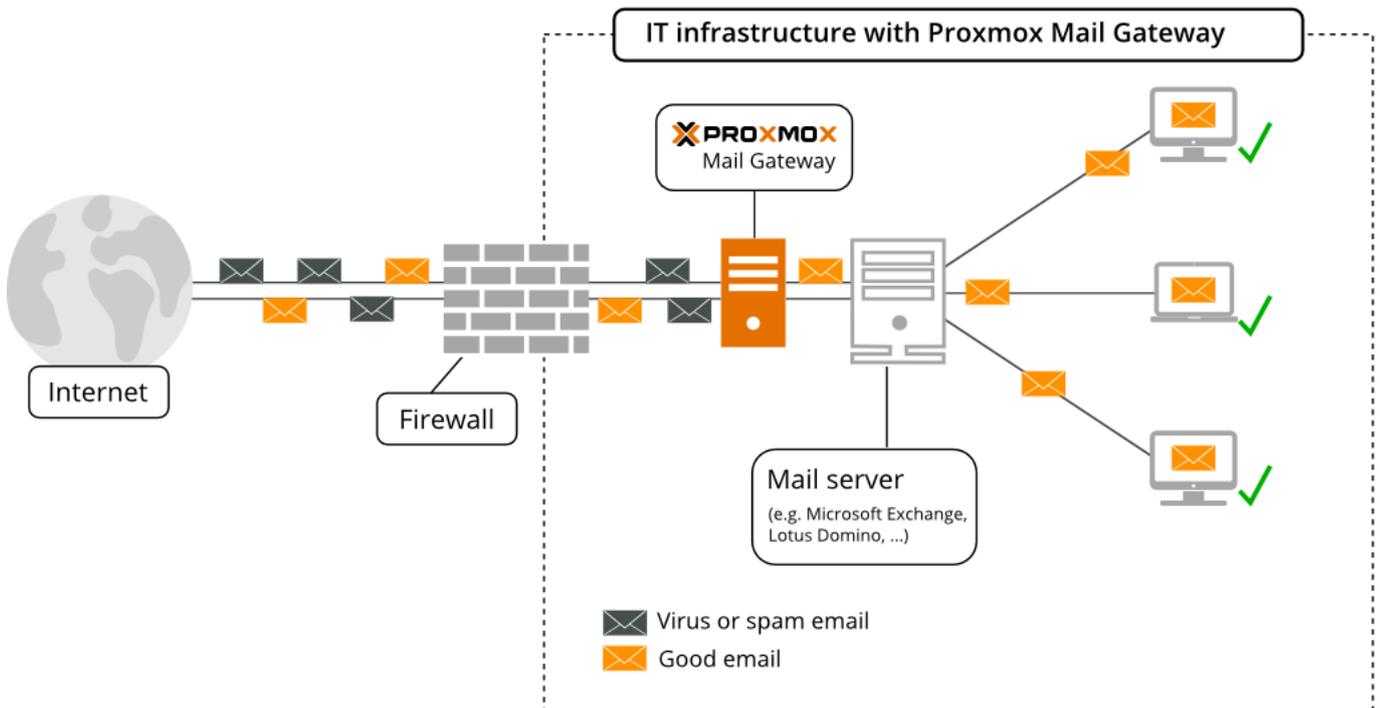
Planning for Deployment

2.1 Easy integration into existing e-mail server architecture

In this sample configuration, your e-mail traffic (SMTP) arrives on the firewall and will be directly forwarded to your e-mail server.



By using the Proxmox Mail Gateway, all your e-mail traffic is forwarded to the Proxmox Mail Gateway, which filters the whole e-mail traffic and removes unwanted e-mails. You can manage incoming and outgoing mail traffic.



2.2 Filtering outgoing e-mails

Many e-mail filter solutions do not scan outgoing mails. Opposed to that Proxmox Mail Gateway is designed to scan both incoming and outgoing e-mails. This has two major advantages:

1. Proxmox Mail Gateway is able to detect viruses sent from an internal host. In many countries you are liable for sending viruses to other people. The Proxmox Mail Gateway outgoing e-mail scanning feature is an additional protection to avoid that.
2. Proxmox Mail Gateway can gather statistics about outgoing e-mails too. Statistics about incoming e-mails looks nice, but they are quite useless. Consider two users, user-1 receives 10 e-mails from news portals and wrote 1 e-mail to a person you never heard from. While user-2 receives 5 e-mails from a customer and sent 5 e-mails back. Which user do you consider more active? I am sure it's user-2, because he communicates with your customers. Proxmox Mail Gateway advanced address statistics can show you this important information. A solution which does not scan outgoing e-mail cannot do that.

To enable outgoing e-mail filtering you just need to send all outgoing "smarthost" on your e-mail server.

2.3 Firewall settings

In order to pass e-mail traffic to the Proxmox Mail Gateway you need to allow traffic on the SMTP the port. Our servers use the Network Time Protocol (NTP) for time synchronization, RAZOR, DNS, SSH, HTTP and port 8006 for the web based management interface.

Service	Port	Protocol	From	To
SMTP	25	TCP	Proxmox	Internet
SMTP	25	TCP	Internet	Proxmox

Service	Port	Protocol	From	To
SMTP	26	TCP	Mailserver	Proxmox
NTP	123	TCP/UDP	Proxmox	Internet
RAZOR	2703	TCP	Proxmox	Internet
DNS	53	TCP/UDP	Proxmox	DNS Server
HTTP	80	TCP	Proxmox	Internet
GUI/API	8006	TCP	Intranet	Proxmox

**Caution**

It is advisable to restrict access to the GUI/API port as far as possible.

The outgoing HTTP connection is mainly used by virus pattern updates, and can be configured to use a proxy instead of a direct internet connection.

You can use the *nmap* utility to test your firewall settings (see section [port scans](#) Section 10.9).

2.4 System Requirements

The Proxmox Mail Gateway can run on dedicated server hardware or inside a virtual machine on any of the following platforms:

- Proxmox VE (KVM)
- VMWare vSphere™ (open-vm tools are integrated in the ISO)
- Hyper-V™ (Hyper-V Linux integration tools are integrated in the ISO)
- KVM (virtio drivers are integrated, great performance)
- Virtual box™
- Citrix Hypervisor™ (former XenServer™)
- LXC container
- and others supporting Debian Linux as guest OS

Please see <http://www.proxmox.com> for details.

In order to get a benchmark from your hardware, just run *pmgperf* after installation.

2.4.1 Minimum System Requirements

- CPU: 64bit (Intel EMT64 or AMD64)
- 2 GB RAM
- bootable CD-ROM-drive or USB boot support
- Monitor with a resolution of 1024x768 for the installation
- Hard disk with at least 8 GB of disk space
- Ethernet network interface card

2.4.2 Recommended System Requirements

- Multicore CPU: 64bit (Intel EMT64 or AMD64),
for use as virtual machine activate Intel VT/AMD-V CPU flag
- 4 GB RAM
- bootable CD-ROM-drive or USB boot support
- Monitor with a resolution of 1024x768 for the installation
- 1 Gbps Ethernet network interface card
- Storage: at least 8 GB free disk space, best setup with redundancy, use hardware RAID controller with battery backed write cache (“BBU”) or ZFS. ZFS is not compatible with a hardware RAID controller. For best performance use Enterprise class SSD with power loss protection.

2.4.3 Supported web browsers for accessing the web interface

To use the web interface you need a modern browser, this includes:

- Firefox, a release from the current year, or the latest Extended Support Release
 - Chrome, a release from the current year
 - Microsofts currently supported version of Edge
 - Safari, a release from the current year
-

Chapter 3

Installation

Proxmox Mail Gateway is based on Debian and comes with an installation CD-ROM which includes a complete Debian ("buster" for version 6.x) system as well as all necessary Proxmox Mail Gateway packages.

The installer just asks you a few questions, then partitions the local disk(s), installs all required packages, and configures the system including a basic network setup. You can get a fully functional system within a few minutes. This is the preferred and recommended installation method.

Alternatively, Proxmox Mail Gateway can be installed on top of an existing Debian system. This option is only recommended for advanced users since it requires more detailed knowledge about Proxmox Mail Gateway and Debian.

3.1 Using the Proxmox Mail Gateway Installation CD-ROM

You can download the ISO from <http://www.proxmox.com>. It includes the following:

- Complete operating system (Debian Linux, 64-bit)
- The Proxmox Mail Gateway installer, which partitions the hard drive(s) with ext4, ext3, xfs or ZFS and installs the operating system.
- Linux kernel
- Postfix MTA, ClamAV, Spamassassin and the Proxmox Mail Gateway toolset
- Web based management interface for using the toolset

Please burn the downloaded ISO image to a CD or create a [bootable USB stick](#) Section 3.2.

Then insert the installation CD-ROM on the physical host where you want to install Proxmox Mail Gateway and boot from that drive. Immediately afterwards you can choose the following menu options:



Install Proxmox Mail Gateway

Start normal installation.

Install Proxmox Mail Gateway (Debug mode)

Start installation in debug mode. It opens a shell console at several installation steps, so that you can debug things if something goes wrong. Please press `CTRL-D` to exit those debug consoles and continue installation. This option is mostly for developers and not meant for general use.

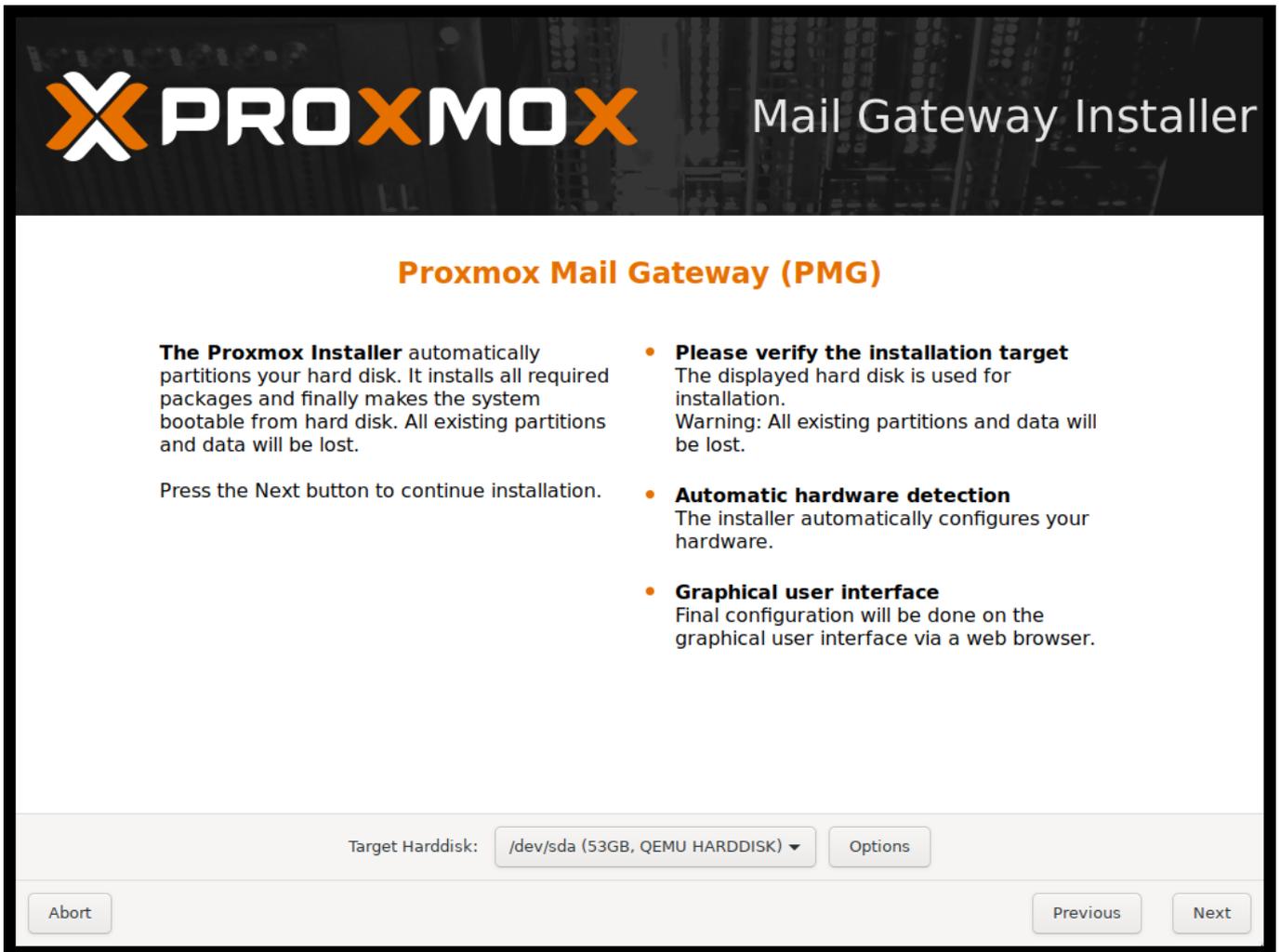
Rescue Boot

This option allows you to boot an existing installation. It searches all attached hard disks and, if it finds an existing installation, boots directly into that disk using the existing Linux kernel. This can be useful if there are problems with the boot block (grub), or the BIOS is unable to read the boot block from the disk.

Test Memory

Runs `memtest86+`. This is useful to check if your memory is functional and error free.

You normally select **Install Proxmox Mail Gateway** to start the installation.



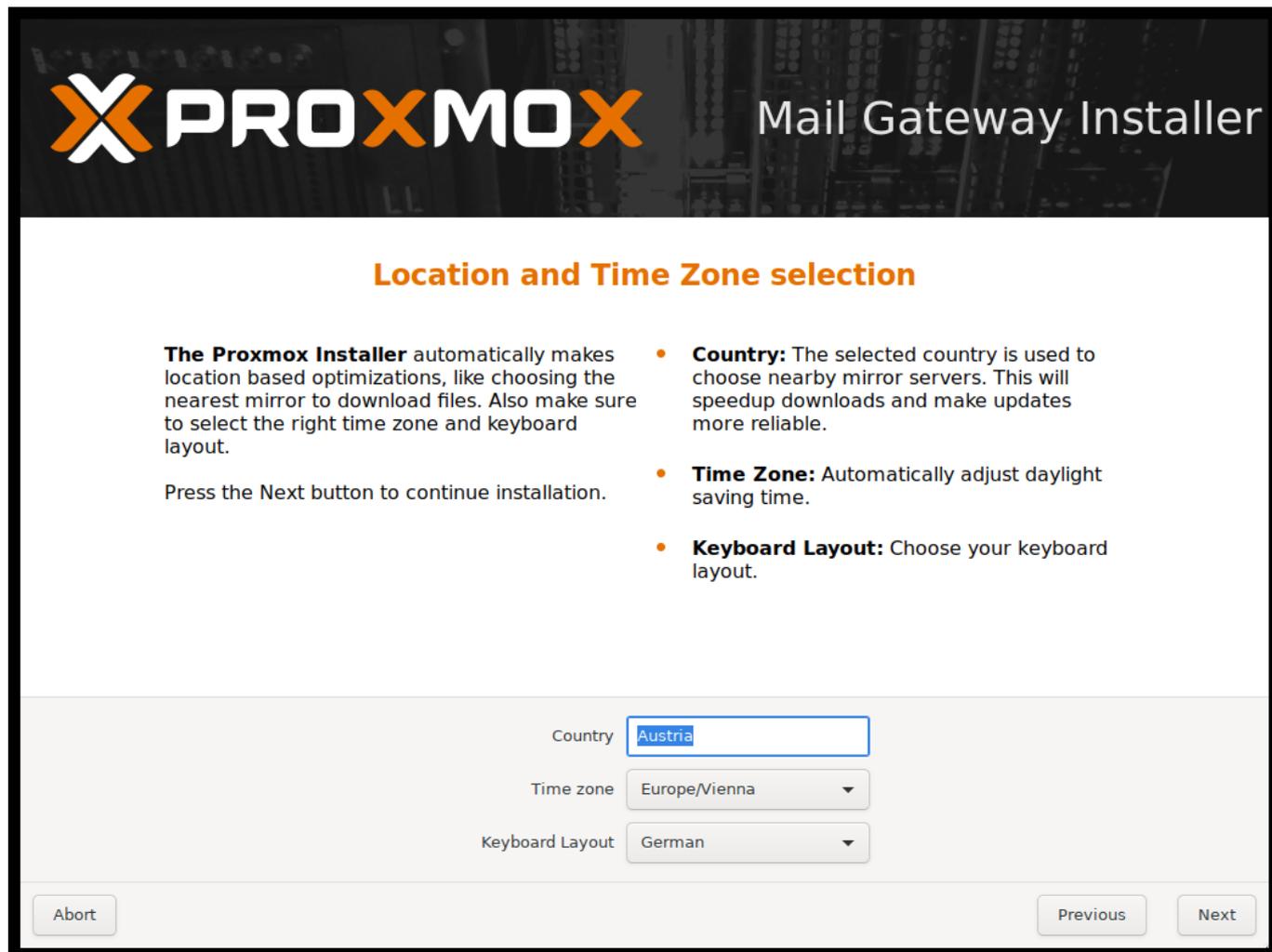
First step is to read our EULA (End User License Agreement). After that you get prompted to select the target hard disk(s).

Note

By default, the complete server is used and all existing data is removed.

The `Options` button lets you select the target file system, which defaults to `ext4`. The installer uses LVM if you select `ext3`, `ext4` or `xfs` as file system, and offers additional option to restrict LVM space (see [below](#))

If you have more than one disk, you can also use ZFS as file system. ZFS supports several software RAID levels, so this is specially useful if you do not have a hardware RAID controller. The `Options` button lets you select the ZFS RAID level, and you can choose disks there.



The screenshot shows the Proxmox Mail Gateway Installer interface. At the top left is the Proxmox logo, and at the top right is the text 'Mail Gateway Installer'. The main heading is 'Location and Time Zone selection'. Below this, there is explanatory text and a list of three items: Country, Time Zone, and Keyboard Layout. At the bottom, there are three input fields: 'Country' with 'Austria' selected, 'Time zone' with 'Europe/Vienna' selected, and 'Keyboard Layout' with 'German' selected. Navigation buttons for 'Abort', 'Previous', and 'Next' are located at the bottom of the screen.

Location and Time Zone selection

The Proxmox Installer automatically makes location based optimizations, like choosing the nearest mirror to download files. Also make sure to select the right time zone and keyboard layout.

Press the Next button to continue installation.

- **Country:** The selected country is used to choose nearby mirror servers. This will speedup downloads and make updates more reliable.
- **Time Zone:** Automatically adjust daylight saving time.
- **Keyboard Layout:** Choose your keyboard layout.

Country: Austria

Time zone: Europe/Vienna

Keyboard Layout: German

Abort Previous Next

The next page just ask for basic configuration options like your location, the time zone and keyboard layout. The location is used to select a download server near you to speedup updates. The installer is usually able to auto detect those setting, so you only need to change them in rare situations when auto detection fails, or when you want to use some special keyboard layout not commonly used in your country.

The screenshot shows the 'Administration Password and E-Mail Address' step of the Proxmox Mail Gateway installer. The title bar at the top left features the Proxmox logo and the text 'Mail Gateway Installer'. The main heading is 'Administration Password and E-Mail Address'. Below this, there is a paragraph describing Proxmox Mail Gateway as a full-featured, highly secure GNU/Linux system based on Debian. To the right, two bullet points provide instructions: 'Password' (strong password, 8+ characters, letters, numbers, symbols) and 'E-Mail' (valid email address for alerts). A note below the bullets says 'Please provide the root password in this step.' and 'Press the Next button to continue installation.' The form area contains three input fields: 'Password' (masked with dots), 'Confirm' (masked with dots), and 'E-Mail' (containing 'mailadmin@example.com'). At the bottom, there are three buttons: 'Abort', 'Previous', and 'Next'.

You then need to specify an email address and the superuser (root) password. The password must have at least 5 characters, but we highly recommend to use stronger passwords - here are some guidelines:

- Use a minimum password length of 12 to 14 characters.
- Include lowercase and uppercase alphabetic characters, numbers and symbols.
- Avoid character repetition, keyboard patterns, dictionary words, letter or number sequences, usernames, relative or pet names, romantic links (current or past) and biographical information (e.g., ID numbers, ancestors' names or dates).

It is sometimes necessary to send notification to the system administrator, for example:

- Information about available package updates.
- Error messages from periodic CRON jobs.

All those notification mails will be sent to the specified email address.

PROXMOX Mail Gateway Installer

Management Network Configuration

Please verify the displayed network configuration. You will need a valid network configuration to access the management interface after installation.

Afterwards press the Next button. You will be shown a list of the options that you chose during the previous steps.

- **IP address:** Set the IP address for your server.
- **Netmask:** Set the netmask of your network.
- **Gateway:** IP address of your gateway or firewall.
- **DNS Server:** IP address of your DNS server.

Management Interface: ens18 - 2e:e9:51:87:7b:85 (virtio_net) ▾

Hostname (FQDN): pmg.example.com

IP Address: 192.168.2.181

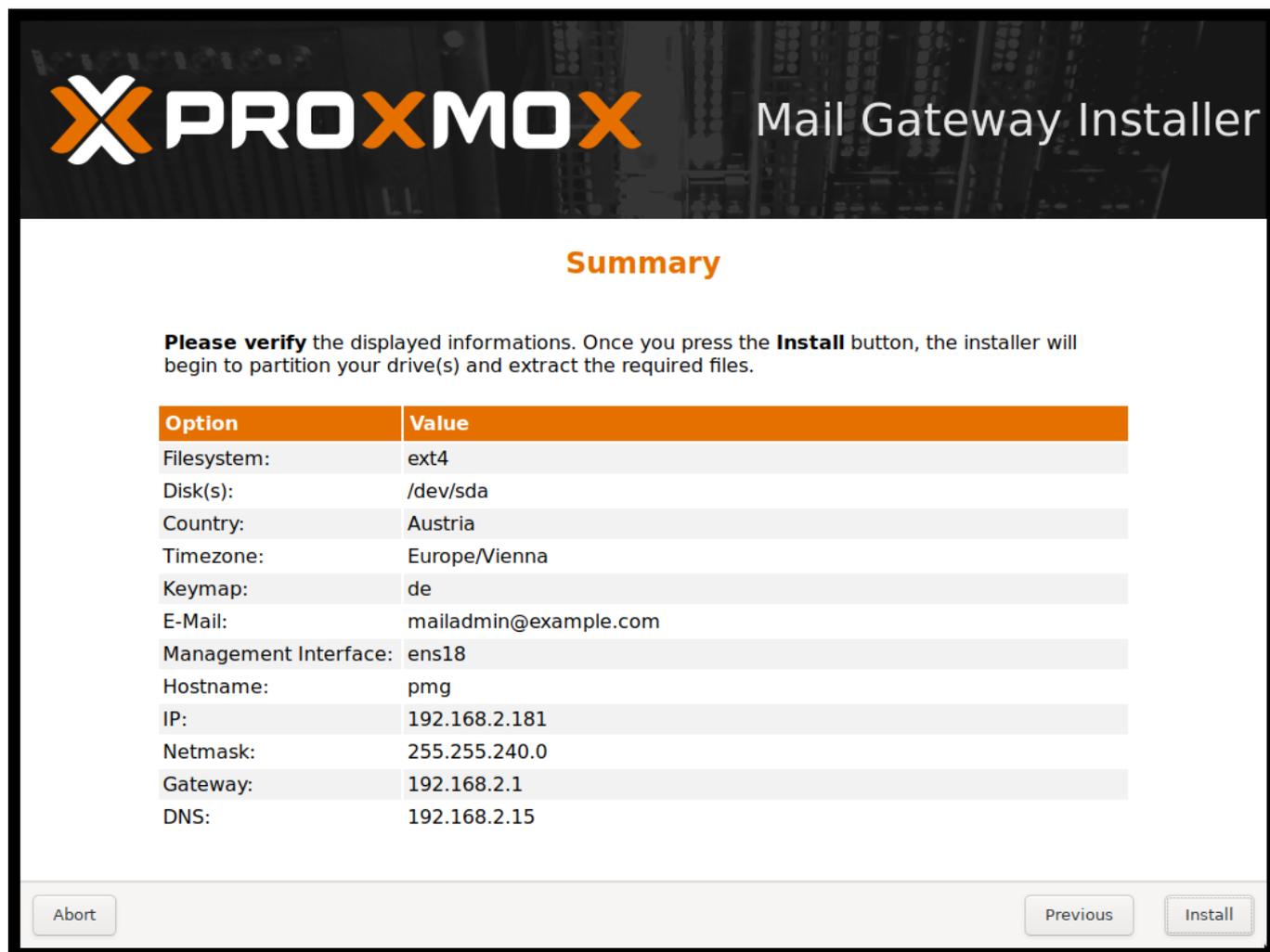
Netmask: 255.255.240.0

Gateway: 192.168.2.1

DNS Server: 192.168.2.15

Abort Previous Next

The next step is the network configuration. Please note that you can use either IPv4 or IPv6 here, but not both. If you want to configure a dual stack node, you can easily do that after installation.

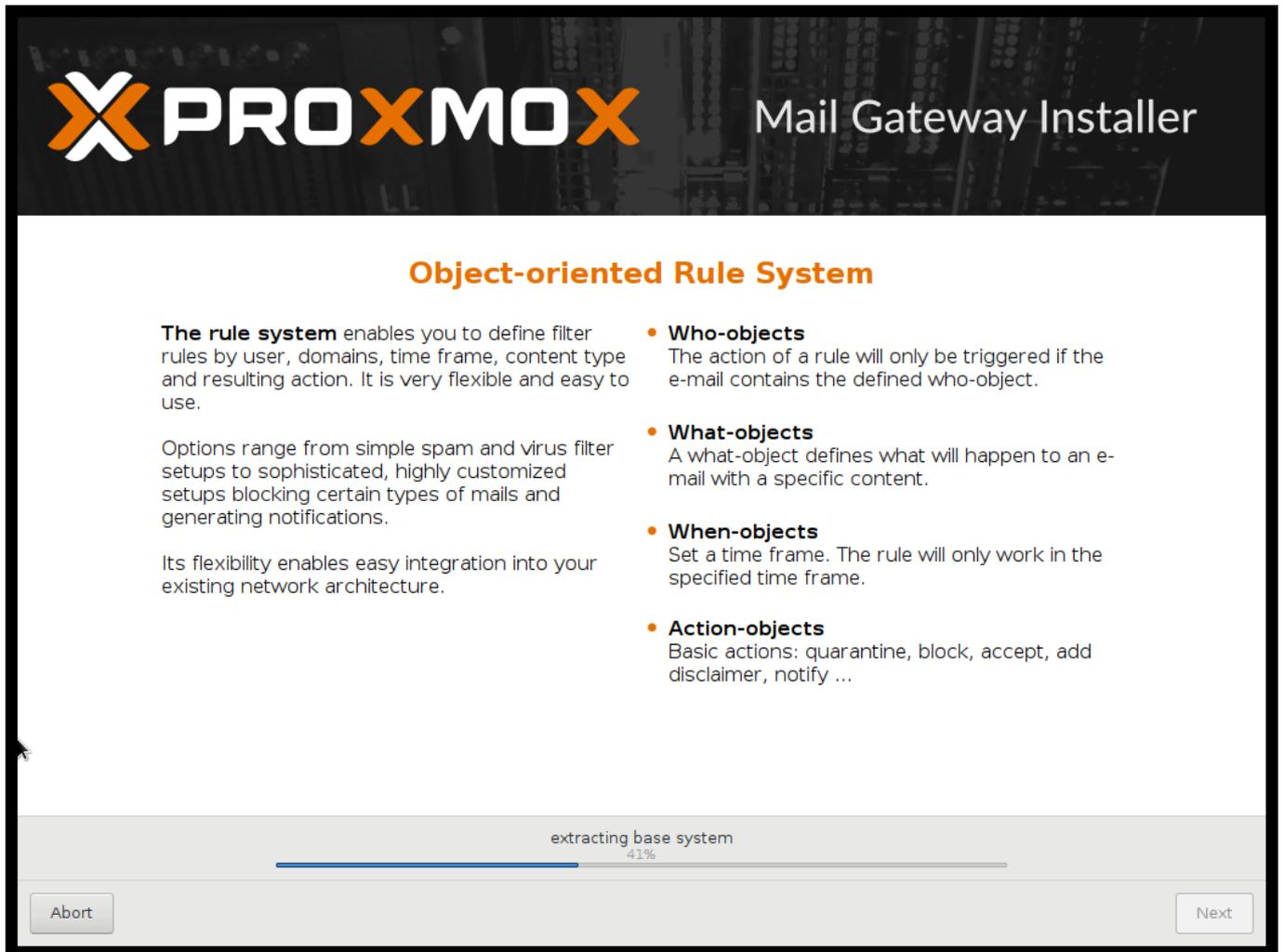


The screenshot shows the Proxmox Mail Gateway Installer interface. At the top left is the Proxmox logo, and at the top right is the text "Mail Gateway Installer". The main heading is "Summary". Below this, a warning message states: "Please verify the displayed informations. Once you press the **Install** button, the installer will begin to partition your drive(s) and extract the required files." A table lists the configuration options and their values. At the bottom, there are three buttons: "Abort", "Previous", and "Install".

Option	Value
Filesystem:	ext4
Disk(s):	/dev/sda
Country:	Austria
Timezone:	Europe/Vienna
Keymap:	de
E-Mail:	mailadmin@example.com
Management Interface:	ens18
Hostname:	pmg
IP:	192.168.2.181
Netmask:	255.255.240.0
Gateway:	192.168.2.1
DNS:	192.168.2.15

If you press `Next`, you will see an overview of your entered configuration. Please re-check every setting, you can still use the `Previous` button to go back and edit any settings.

If you press `Install` now, the installation process starts to format disks, and copies packages to the target disk(s).



Copying packages usually takes a few minutes. Please wait until that is finished, then reboot the server.

Further configuration is done via the Proxmox web interface. Just point your browser to the IP address given during installation (<https://youripaddress:8006>).

1. Login and upload subscription key.

Note

Default login is "root" and the root password is defined during the installation process.

2. Check the IP configuration and hostname.
 3. Check and save the Time Zone.
 4. Check your [Firewall settings](#) Section 2.3.
 5. Configure Proxmox Mail Gateway to forward the incoming SMTP traffic to your Mail server (*Configuration/Mail Proxy/Default Relay*) - *Default Relay* is your e-mail server.
 6. Configure your e-mail server to send all outgoing messages through your Proxmox Mail Gateway (*Smart Host*, port 26 by default).
-

For detailed deployment scenarios see chapter [Planning for Deployment Chapter 2](#).

If the installation succeeds you have to route all your incoming and outgoing e-mail traffic to the Mail Gateway. For incoming traffic you have to configure your firewall and/or DNS settings. For outgoing traffic you need to change the existing e-mail server configuration.

3.1.1 Advanced LVM Configuration Options

The installer creates a Volume Group (VG) called `pmg`, and additional Logical Volumes (LVs) called `root` and `swap`. The size of those volumes can be controlled with:

hdsize

Defines the total HD size to be used. This way you can save free space on the HD for further partitioning (i.e. for an additional PV and VG on the same hard disk that can be used for LVM storage).

swapsize

Defines the size of the `swap` volume. The default is the size of the installed memory, minimum 4 GB and maximum 8 GB. The resulting value cannot be greater than `hdsize/8`.

minfree

Defines the amount of free space left in LVM volume group `pmg`. With more than 128GB storage available the default is 16GB, else `hdsize/8` will be used.

Note

LVM requires free space in the VG for snapshot creation (not required for `lvmthin` snapshots).

3.1.2 ZFS Performance Tips

ZFS uses a lot of memory, so it is best to add additional RAM if you want to use ZFS. A good calculation is 4GB plus 1GB RAM for each TB RAW disk space.

ZFS also provides the feature to use a fast SSD drive as write cache. The write cache is called the ZFS Intent Log (ZIL). You can add that after installation using the following command:

```
zpool add <pool-name> log </dev/path_to_fast_ssd>
```

3.2 Install from USB Stick

The Proxmox Mail Gateway installation media is now a hybrid ISO image, working in two ways:

- An ISO image file ready to burn on CD
- A raw sector (IMG) image file ready to directly copy to flash media (USB Stick)

Using USB sticks is faster and more environmental friendly and therefore the recommended way to install Proxmox Mail Gateway.

3.2.1 Prepare a USB flash drive as install medium

In order to boot the installation media, copy the ISO image to a USB media.

First download the ISO image from <https://www.proxmox.com/en/downloads/category/proxmox-mail-gateway>

You need at least a 1 GB USB media.

Note

Using UNetbootin or Rufus does not work.

**Important**

Make sure that the USB media is not mounted and does not contain any important data.

3.2.2 Instructions for GNU/Linux

You can simply use `dd` on UNIX like systems. First download the ISO image, then plug in the USB stick. You need to find out what device name gets assigned to the USB stick (see below). Then run:

```
dd if=proxmox-mailgateway_*.iso of=/dev/XYZ bs=1M
```

Note

Be sure to replace `/dev/XYZ` with the correct device name.

**Caution**

Be very careful, and do not overwrite the hard disk!

Find Correct USB Device Name

You can compare the last lines of `dmesg` command before and after the insertion, or use the `lsblk` command. Open a terminal and run:

```
lsblk
```

Then plug in your USB media and run the command again:

```
lsblk
```

A new device will appear, and this is the USB device you want to use.

3.2.3 Instructions for OSX

Open the terminal (query Terminal in Spotlight).

Convert the .iso file to .img using the convert option of hdiutil for example.

```
hdiutil convert -format UDRW -o proxmox-mailgateway_*.dmg proxmox- ↵  
mailgateway_*.iso
```

Tip

OS X tends to put the .dmg ending on the output file automatically.

To get the current list of devices run the command again:

```
diskutil list
```

Now insert your USB flash media and run this command again to determine the device node assigned to your flash media (e.g. /dev/diskX).

```
diskutil list
```

```
diskutil unmountDisk /dev/diskX
```

Note

replace X with the disk number from the last command.

```
sudo dd if=proxmox-mailgateway_*.dmg of=/dev/rdiskN bs=1m
```

3.2.4 Instructions for Windows

Download Etcher from <https://etcher.io> , select the ISO and your USB Drive.

If this doesn't work, alternatively use the OSForensics USB installer from <http://www.osforensics.com/portability.htm>

3.2.5 Boot your server from USB media

Connect your USB media to your server and make sure that the server boots from USB (see server BIOS). Then follow the installation wizard.

3.3 Install Proxmox Mail Gateway on Debian

Proxmox Mail Gateway ships as a set of Debian packages, so you can install it on top of a normal Debian installation. After configuring the repositories, you need to run:

```
apt-get update
apt-get install proxmox-mailgateway
```

Installing on top of an existing Debian installation looks easy, but it presumes that you have correctly installed the base system, and you know how you want to configure and use the local storage. Network configuration is also completely up to you.

Note

In general, this is not trivial, especially when you use LVM or ZFS.

3.4 Install Proxmox Mail Gateway as Linux Container Appliance

The full functionality of Proxmox Mail Gateway can also run on top of a Debian-based LXC instance. In order to keep the set of installed software, and thus the necessary updates, minimal you can use the `proxmox-mailgateway-container` meta-package. It does not depend on any Linux Kernel, firmware, or components used for booting from bare-metal, like grub2.

A ready-to-use appliance template is available through the [Proxmox VE](#) appliance manager in the `mail` section, so if you already use Proxmox VE you can setup a Proxmox Mail Gateway instance in a minute.

Note

It's recommended to use a static network configuration. If DHCP should be used ensure that the container can always lease the same IP, for example, by reserving one with the containers network MAC address.

Additionally you can also install this on top of a normal Debian installation. After configuring the repositories, you need to run:

```
apt-get update
apt-get install proxmox-mailgateway-container
```

3.5 Package Repositories

All [Debian](#) based systems use [APT](#) as package management tool. The list of repositories is defined in `/etc/apt/sources.list` and `.list` files found inside `/etc/apt/sources.d/`. Updates can be installed directly using `apt-get`, or via the GUI.

`apt sources.list` files list one package repository per line, with the most preferred source listed first. Empty lines are ignored, and a `#` character anywhere on a line marks the remainder of that line as a comment. The information available from the configured sources is acquired by `apt-get update`.

File /etc/apt/sources.list

```
deb http://ftp.debian.org/debian buster main contrib
deb http://ftp.debian.org/debian buster-updates main contrib
# security updates
deb http://security.debian.org/debian-security buster/updates main contrib
```

In addition, Proxmox Mail Gateway provides three different package repositories.

3.5.1 Proxmox Mail Gateway Enterprise Repository

This is the default, stable and recommended repository, available for all Proxmox Mail Gateway subscription users. It contains the most stable packages, and is suitable for production use. The `pmg-enterprise` repository is enabled by default:

File /etc/apt/sources.list.d/pmg-enterprise.list

```
deb https://enterprise.proxmox.com/debian/pmg buster pmg-enterprise
```

As soon as updates are available, the `root@pam` user is notified via email about the available new packages. On the GUI, the change-log of each package can be viewed (if available), showing all details of the update. So you will never miss important security fixes.

Please note that and you need a valid subscription key to access this repository. We offer different support levels, and you can find further details at <https://www.proxmox.com/en/proxmox-mail-gateway/pricing>.

Note

You can disable this repository by commenting out the above line using a `#` (at the start of the line). This prevents error messages if you do not have a subscription key. Please configure the `pmg-no-subscription` repository in that case.

3.5.2 Proxmox Mail Gateway No-Subscription Repository

As the name suggests, you do not need a subscription key to access this repository. It can be used for testing and non-production use. Its not recommended to run on production servers, as these packages are not always heavily tested and validated.

We recommend to configure this repository in `/etc/apt/sources.list`.

File /etc/apt/sources.list

```
deb http://ftp.debian.org/debian buster main contrib
# PMG pmg-no-subscription repository provided by proxmox.com,
# NOT recommended for production use
```

```
deb http://download.proxmox.com/debian/pmg buster pmg-no-subscription
# security updates
deb http://security.debian.org/debian-security buster/updates main contrib
```

3.5.3 Proxmox Mail Gateway Test Repository

Finally, there is a repository called `pmgtest`. This one contains the latest packages and is heavily used by developers to test new features. As usual, you can configure this using `/etc/apt/sources.list` by adding the following line:

sources.list entry for pmgtest

```
deb http://download.proxmox.com/debian/pmg buster pmgtest
```



Warning

the `pmgtest` repository should (as the name implies) only be used for testing new features or bug fixes.

3.5.4 SecureApt

We use GnuPG to sign the `Release` files inside those repositories, and APT uses that signatures to verify that all packages are from a trusted source.

The key used for verification is already installed if you install from our installation CD. If you install by other means, you can manually download the key with:

```
# wget http://download.proxmox.com/debian/proxmox-ve-release-6.x.gpg ←
-O /etc/apt/trusted.gpg.d/proxmox-ve-release-6.x.gpg
```

Please verify the checksum afterwards:

```
# sha512sum /etc/apt/trusted.gpg.d/proxmox-ve-release-6.x.gpg
acca6f416917e8e11490a08a1e2842d500b3a5d9f322c6319db0927b2901c3eae23cfb5cd5df6facf21
/etc/apt/trusted.gpg.d/proxmox-ve-release-6.x.gpg
```

or

```
# md5sum /etc/apt/trusted.gpg.d/proxmox-ve-release-6.x.gpg
f3f6c5a3a67baf38ad178e5ff1ee270c /etc/apt/trusted.gpg.d/proxmox-ve-release ←
-6.x.gpg
```

Chapter 4

Configuration Management

Proxmox Mail Gateway is usually configured using the web-based Graphical User Interface (GUI), but it is also possible to directly edit the configuration files, use the REST API over *https* or the command line tool `pmgsh`.

The command line tool `pmgconfig` is used to simplify some common configuration tasks, i.e. to generate certificates and to rewrite service configuration files.

Note

We use a Postgres database to store mail filter rules and statistic data. See chapter [Database Management](#) Section 10.1 for more information.

4.1 Configuration files overview

`/etc/network/interfaces`

Network setup. We never modify this files directly. Instead, we write changes to `/etc/network/interfaces.d`. When you reboot, we rename the file to `/etc/network/interfaces`, so any changes gets activated on the next reboot.

`/etc/resolv.conf`

DNS search domain and nameserver setup.

`/etc/hostname`

The system's host name.

`/etc/hosts`

Static table lookup for hostnames.

`/etc/pmg/pmg.conf`

Stores common administration options, i.e. the spam and mail proxy setup.

`/etc/pmg/cluster.conf`

The cluster setup.

/etc/pmg/domains

The list of relay domains.

/etc/pmg/dkim/domains

The list of domains for outbound DKIM signing.

/etc/pmg/fetchmailrc

Fetchmail configuration (POP3 and IMAP setup).

/etc/pmg/ldap.conf

LDAP configuration.

/etc/pmg/mynetworks

List of local (trusted) networks.

/etc/pmg/subscription

Stores your subscription key and status.

/etc/pmg/tls_policy

TLS policy for outbound connections.

/etc/pmg/transports

Message delivery transport setup.

/etc/pmg/user.conf

GUI user configuration.

/etc/mail/spamassassin/custom.cf

Custom **SpamAssassin™** setup.

/etc/mail/spamassassin/pmg-scores.cf

Custom **SpamAssassin™** rule scores.

4.2 Keys and Certificates

/etc/pmg/pmg-api.pem

Key and certificate (combined) used by the HTTPs server (API).

/etc/pmg/pmg-authkey.key

Private key used to generate authentication tickets.

/etc/pmg/pmg-authkey.pub

Public key used to verify authentication tickets.

/etc/pmg/pmg-csrf.key

Internally used to generate CSRF tokens.

/etc/pmg/pmg-tls.pem

Key and certificate (combined) to encrypt mail traffic (TLS).

/etc/pmg/dkim/<selector>.private

Key for DKIM signing mails with selector <selector>.

4.3 Service Configuration Templates

Proxmox Mail Gateway uses various services to implement mail filtering, for example the [Postfix](#) Mail Transport Agent (MTA), the [ClamAV®](#) antivirus engine and the Apache [SpamAssassin™](#) project. Those services use separate configuration files, so we need to rewrite those files when configuration is changed.

We use a template based approach to generate those files. The [Template Toolkit](#) is a well known, fast and flexible template processing system. You can find the default templates in `/var/lib/pmg/templates/`. Please do not modify them directly, because your modification would get lost on the next update. Instead, copy the template you wish to change to `/etc/pmg/templates/`, then apply your changes there.

Templates can access any configuration setting, and you can use the `pmgconfig dump` command to get a list of all variable names:

```
# pmgconfig dump
...
dns.domain = yourdomain.tld
dns.hostname = pmg
ipconfig.int_ip = 192.168.2.127
pmg.admin.advfilter = 1
...
```

The same tool is used to force regeneration of all template based configuration files. You need to run that after modifying a template, or when you directly edit configuration files

```
# pmgconfig sync --restart 1
```

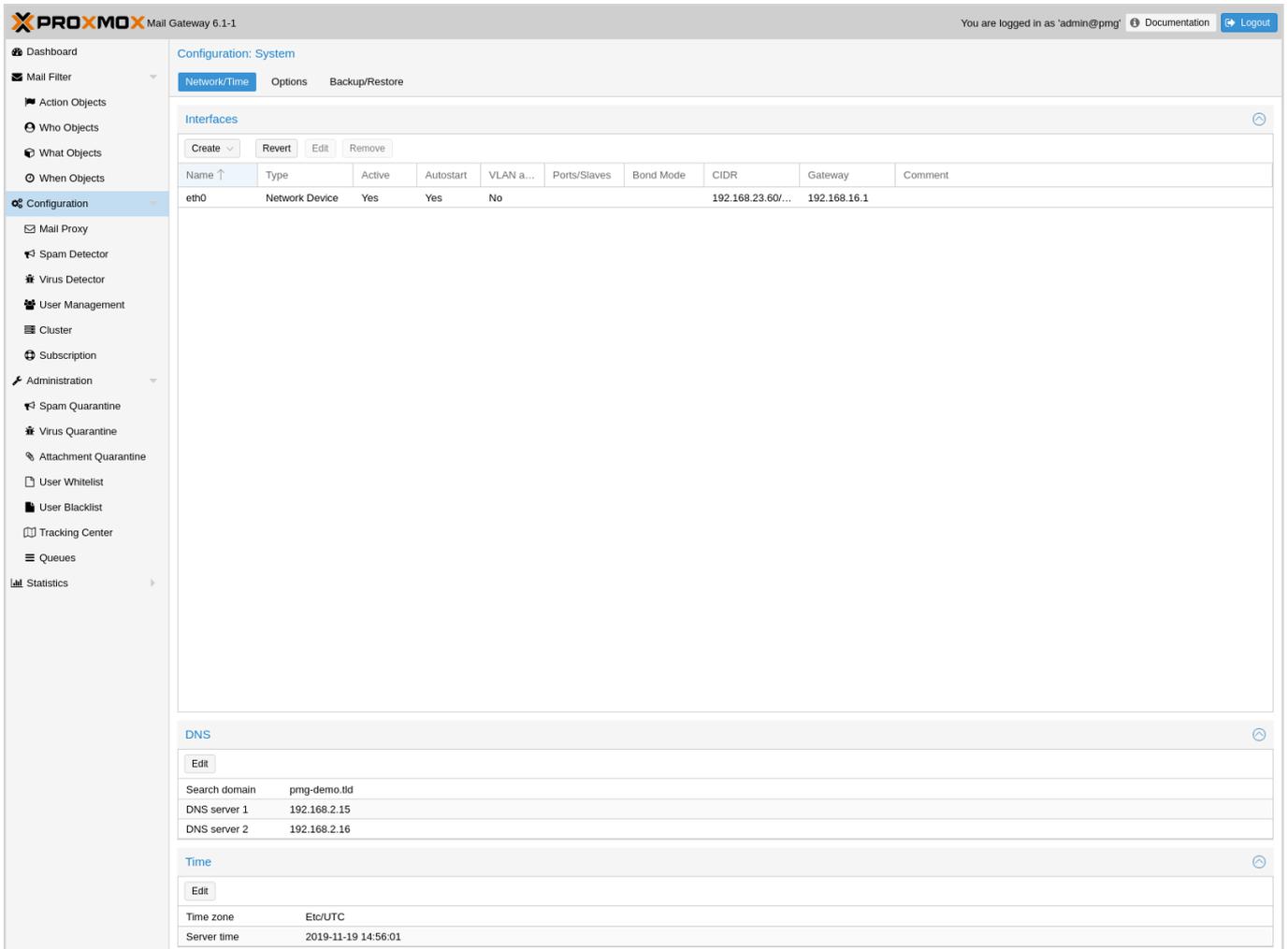
The above command also restarts services if the underlying configuration files are changed. Please note that this is automatically done when you change the configuration using the GUI or API.

Note

Modified templates from `/etc/pmg/templates/` are automatically synced from the master node to all cluster members.

4.4 System Configuration

4.4.1 Network and Time



The screenshot shows the Proxmox Mail Gateway 6.1-1 GUI. The left sidebar contains a navigation menu with categories like Mail Filter, Action Objects, Who Objects, What Objects, When Objects, Configuration, Mail Proxy, Spam Detector, Virus Detector, User Management, Cluster, Subscription, Administration, and Statistics. The main content area is titled 'Configuration: System' and has tabs for 'Network/Time', 'Options', and 'Backup/Restore'. The 'Network/Time' tab is active, showing an 'Interfaces' table with one entry for eth0. Below the table are sections for 'DNS' and 'Time' configuration.

Name	Type	Active	Autostart	VLAN a...	Ports/Slaves	Bond Mode	CIDR	Gateway	Comment
eth0	Network Device	Yes	Yes	No			192.168.23.60/...	192.168.16.1	

DNS

Search domain	pmg-demo.tld
DNS server 1	192.168.2.15
DNS server 2	192.168.2.16

Time

Time zone	Etc/UTC
Server time	2019-11-19 14:56:01

Normally the network and time is already configured when you visit the GUI. The installer asks for those settings and sets up the correct values.

The default setup uses a single Ethernet adapter and static IP assignment. The configuration is stored at `/etc/network/interfaces`, and the actual network setup is done the standard Debian way using package `ifupdown`.

Example network setup `/etc/network/interfaces`

```
source /etc/network/interfaces.d/*

auto lo
iface lo inet loopback

auto ens18
iface ens18 inet static
    address 192.168.2.127
    netmask 255.255.240.0
```

gateway 192.168.2.1

DNS recommendations

Many tests to detect SPAM mails use DNS queries, so it is important to have a fast and reliable DNS server. We also query some public available DNS Blacklists. Most of them apply rate limits for clients, so they simply will not work if you use a public DNS server (because they are usually blocked). We recommend to use your own DNS server, which need to be configured in *recursive* mode.

4.4.2 Options

Those settings are saved to subsection *admin* in `/etc/pmg/pmg.conf`, using the following configuration keys:

advfilter: <boolean> (**default = 1**)

Use advanced filters for statistic.

avast: <boolean> (**default = 0**)

Use Avast Virus Scanner (`/usr/bin/scan`). You need to buy and install *Avast Core Security* before you can enable this feature.

clamav: <boolean> (*default = 1*)

Use ClamAV Virus Scanner. This is the default virus scanner and is enabled by default.

custom_check: <boolean> (*default = 0*)

Use Custom Check Script. The script has to take the defined arguments and can return Virus findings or a Spamscore.

custom_check_path: `^ / ([^\0]+\/)+ [^\0]+$` (*default = /usr/local/bin/pmg-custom-check*)

Absolute Path to the Custom Check Script

dailyreport: <boolean> (*default = 1*)

Send daily reports.

demo: <boolean> (*default = 0*)

Demo mode - do not start SMTP filter.

dkim_selector: <string>

Default DKIM selector

dkim_sign: <boolean> (*default = 0*)

DKIM sign outbound mails with the configured Selector.

dkim_sign_all_mail: <boolean> (*default = 0*)

DKIM sign all outgoing mails irrespective of the Envelope From domain.

email: <string> (*default = admin@domain.tld*)

Administrator E-Mail address.

http_proxy: `http://.*`

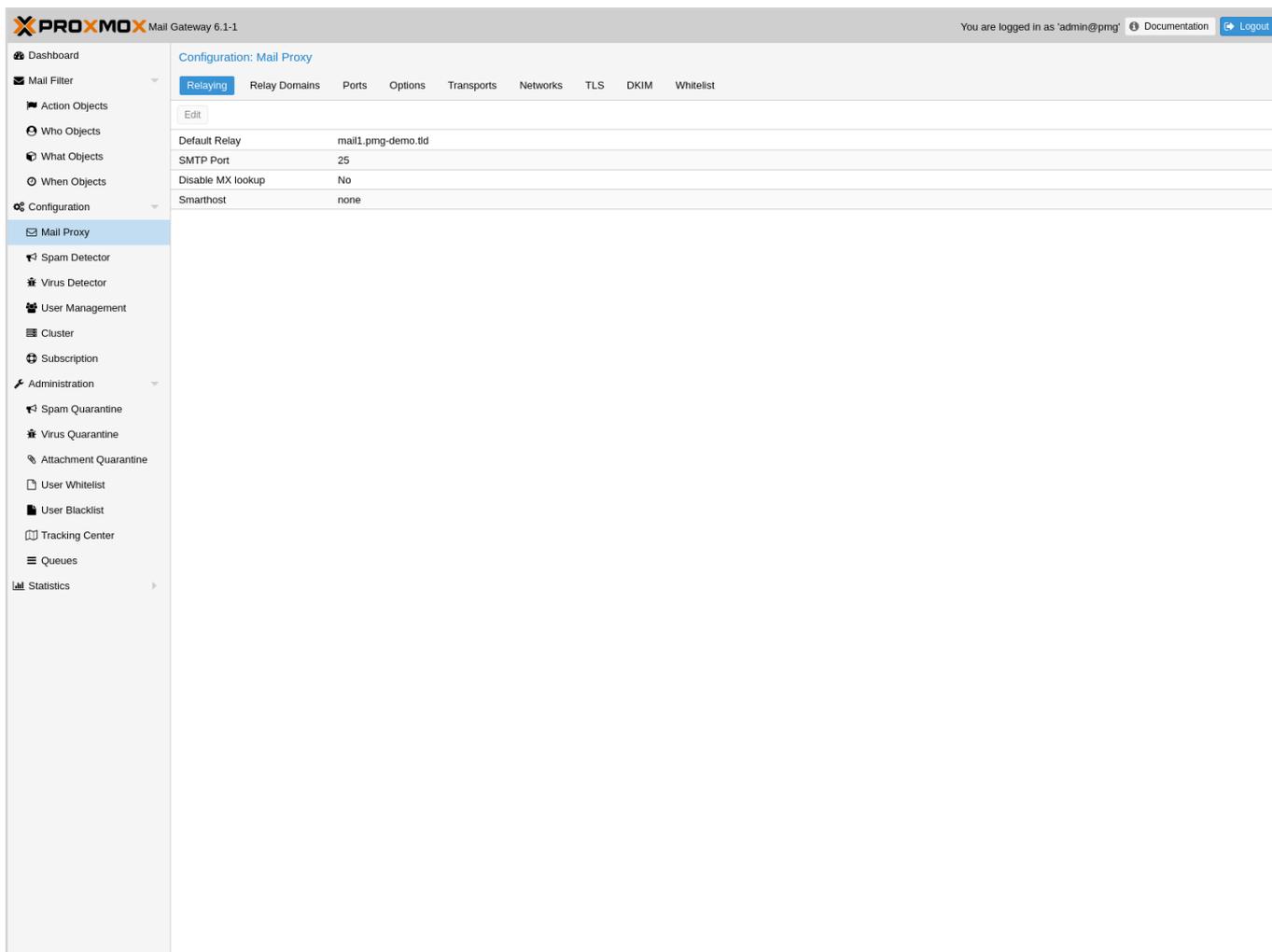
Specify external http proxy which is used for downloads (example: `http://username:password@host:port/`)

statlifetime: <integer> (1 - N) (*default = 7*)

User Statistics Lifetime (days)

4.5 Mail Proxy Configuration

4.5.1 Relaying



Those settings are saved to subsection *mail* in `/etc/pmg/pmg.conf`, using the following configuration keys:

relay: <string>

The default mail delivery transport (incoming mails).

relaynomx: <boolean> (*default = 0*)

Disable MX lookups for default relay.

relayport: <integer> (1 – 65535) (*default = 25*)

SMTP port number for relay host.

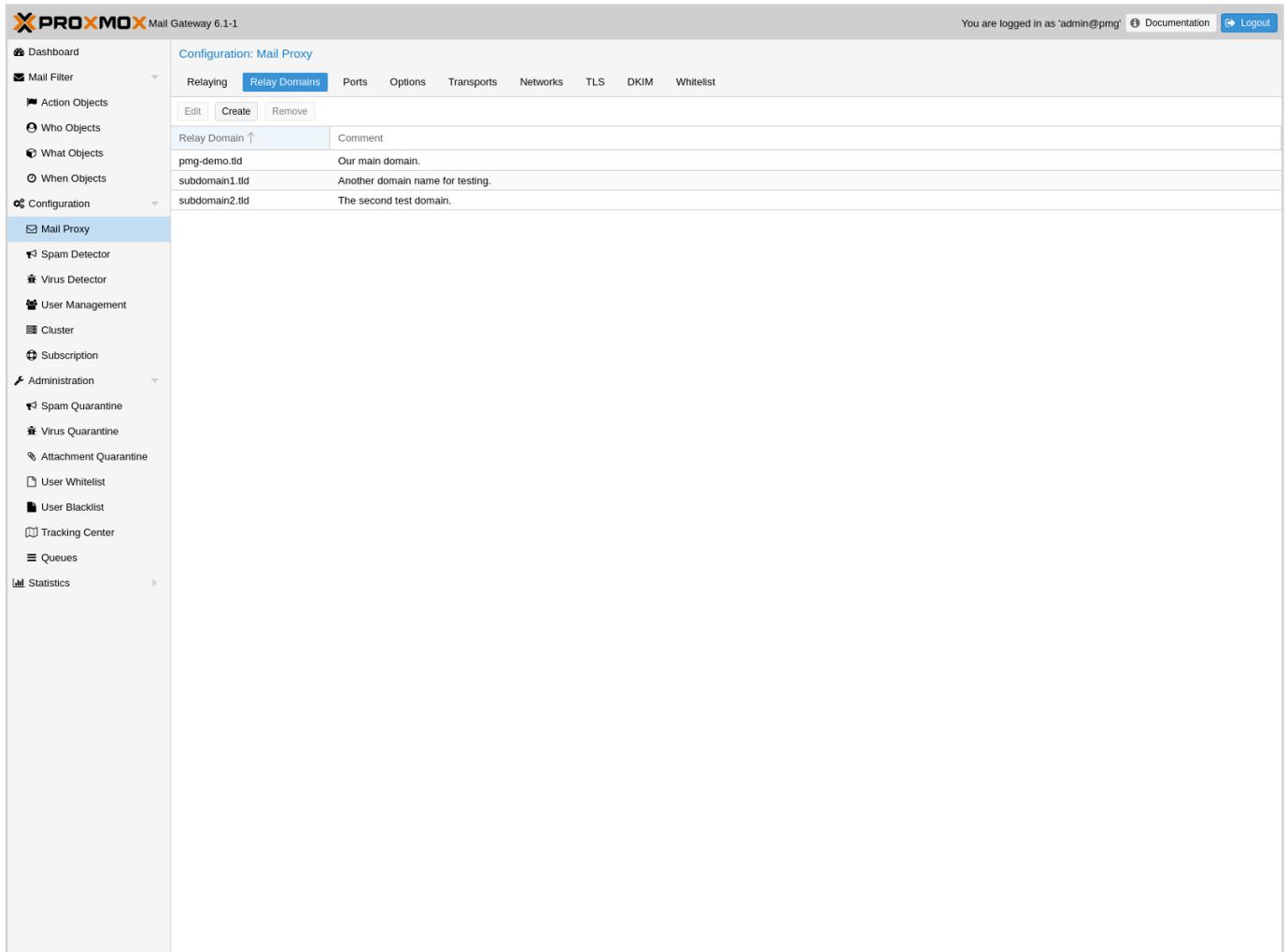
smarthost: <string>

When set, all outgoing mails are delivered to the specified smarthost.

smarthostport: <integer> (1 – 65535) (*default = 25*)

SMTP port number for smarthost.

4.5.2 Relay Domains

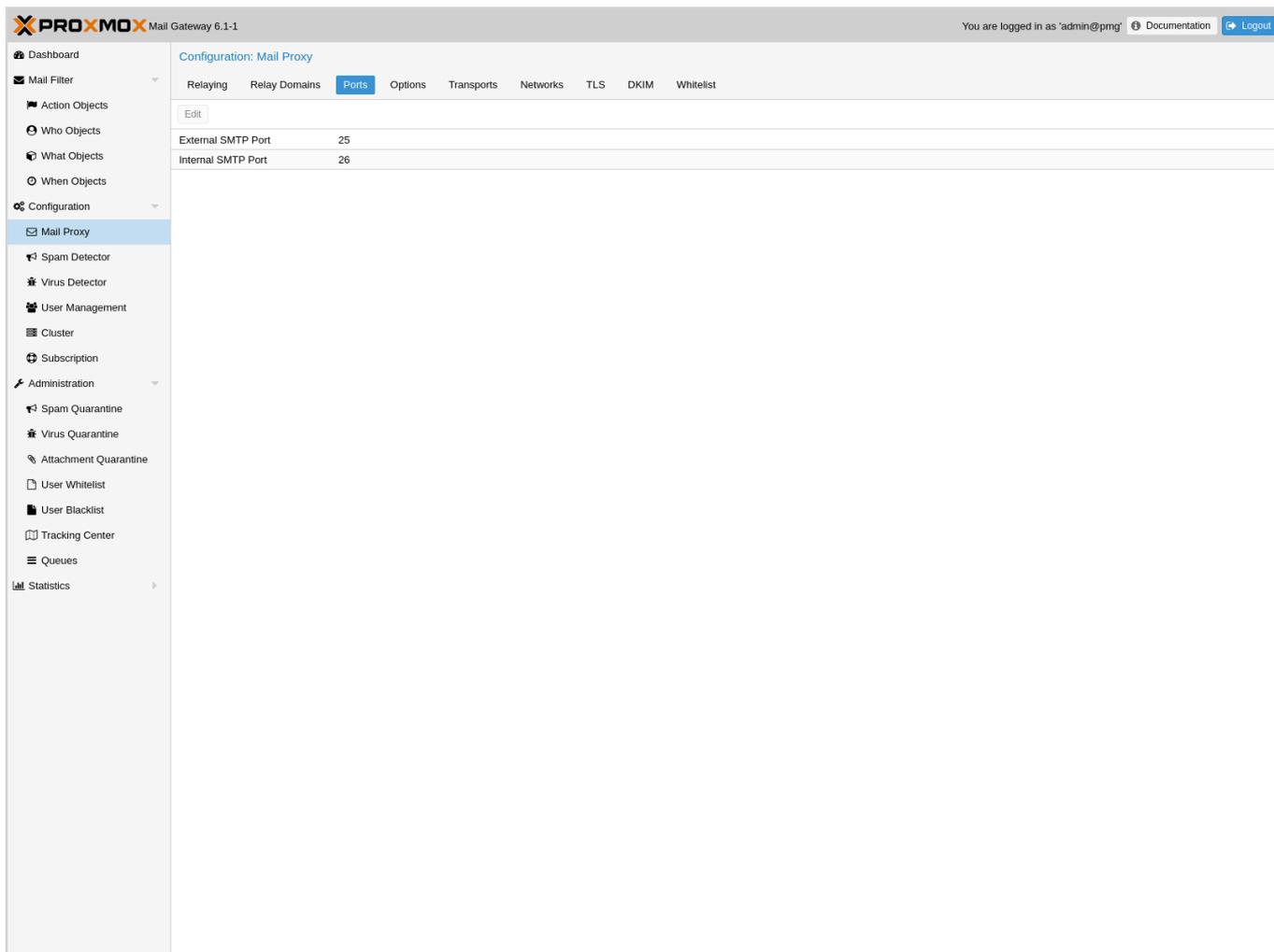


The screenshot shows the Proxmox Mail Gateway administration interface. The top navigation bar includes the Proxmox logo, the version 'Mail Gateway 6.1-1', and the user 'admin@pmg'. The left sidebar contains a navigation menu with categories like 'Mail Filter', 'Configuration', and 'Administration'. The main content area is titled 'Configuration: Mail Proxy' and has tabs for 'Relaying', 'Ports', 'Options', 'Transports', 'Networks', 'TLS', 'DKIM', and 'Whitelist'. The 'Relaying' tab is active, showing a table of relay domains.

Relay Domain	Comment
pmg-demo.tld	Our main domain.
subdomain1.tld	Another domain name for testing.
subdomain2.tld	The second test domain.

List of relayed mail domains, i.e. what destination domains this system will relay mail to. The system will reject incoming mails to other domains.

4.5.3 Ports



The screenshot displays the Proxmox Mail Gateway administration interface. The top navigation bar shows the Proxmox logo and the version 'Mail Gateway 6.1-1'. The user is logged in as 'admin@pmg'. The main content area is titled 'Configuration: Mail Proxy' and has several tabs: 'Relaying', 'Relay Domains', 'Ports', 'Options', 'Transports', 'Networks', 'TLS', 'DKIM', and 'Whitelist'. The 'Ports' tab is active, showing a table with the following configuration:

Port Name	Value
External SMTP Port	25
Internal SMTP Port	26

Those settings are saved to subsection *mail* in `/etc/pmg/pmg.conf`, using the following configuration keys:

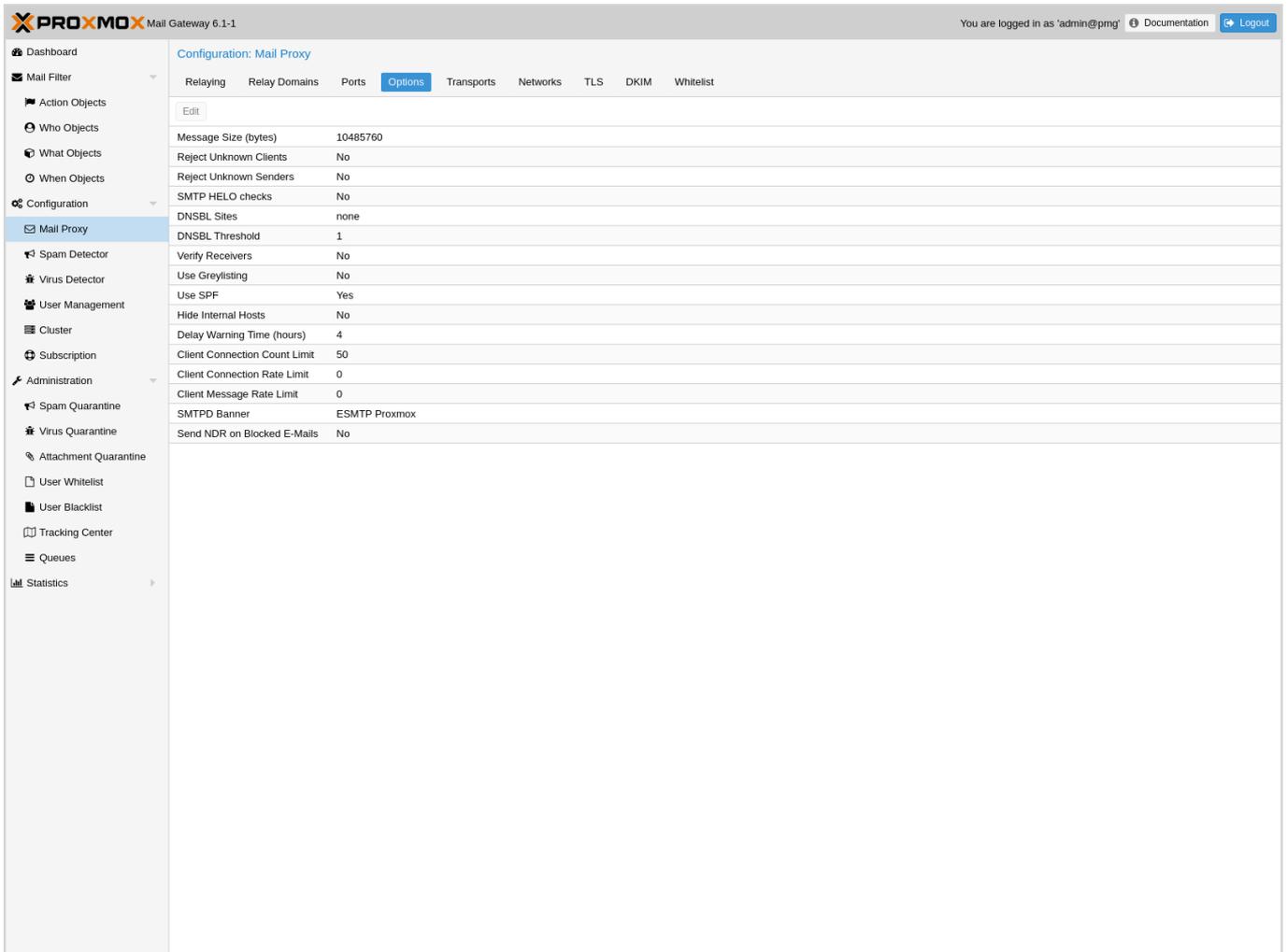
ext_port: <integer> (1 - 65535) (default = 25)

SMTP port number for incoming mail (untrusted). This must be a different number than *int_port*.

int_port: <integer> (1 - 65535) (default = 26)

SMTP port number for outgoing mail (trusted).

4.5.4 Options



The screenshot shows the Proxmox Mail Gateway 6.1-1 web interface. The user is logged in as 'admin@pmg'. The main content area is titled 'Configuration: Mail Proxy' and has several tabs: 'Relaying', 'Relay Domains', 'Ports', 'Options' (selected), 'Transports', 'Networks', 'TLS', 'DKIM', and 'Whitelist'. Below the tabs is an 'Edit' button. The configuration table lists the following settings:

Message Size (bytes)	10485760
Reject Unknown Clients	No
Reject Unknown Senders	No
SMTP HELO checks	No
DNSBL Sites	none
DNSBL Threshold	1
Verify Receivers	No
Use Greylisting	No
Use SPF	Yes
Hide Internal Hosts	No
Delay Warning Time (hours)	4
Client Connection Count Limit	50
Client Connection Rate Limit	0
Client Message Rate Limit	0
SMTPD Banner	ESMTP Proxmox
Send NDR on Blocked E-Mails	No

Those settings are saved to subsection *mail* in `/etc/pmg/pmg.conf`, using the following configuration keys:

banner: <string> (**default = ESMTP Proxmox**)
ESMTP banner.

before_queue_filtering: <boolean> (**default = 0**)
Enable before queue filtering by pmg-smtp-filter

conn_count_limit: <integer> (0 - N) (**default = 50**)
How many simultaneous connections any client is allowed to make to this service. To disable this feature, specify a limit of 0.

conn_rate_limit: <integer> (0 - N) (**default = 0**)
The maximal number of connection attempts any client is allowed to make to this service per minute. To disable this feature, specify a limit of 0.

dnsbl_sites: <string>
Optional list of DNS white/blacklist domains (see `postscreen_dnsbl_sites` parameter).

dnsbl_threshold: <integer> (0 - N) (default = 1)

The inclusive lower bound for blocking a remote SMTP client, based on its combined DNSBL score (see `postscreen_dnsbl_threshold` parameter).

dwarning: <integer> (0 - N) (default = 4)

SMTP delay warning time (in hours).

greylist: <boolean> (default = 1)

Use Greylisting.

helotests: <boolean> (default = 0)

Use SMTP HELO tests.

hide_received: <boolean> (default = 0)

Hide received header in outgoing mails.

maxsize: <integer> (1024 - N) (default = 10485760)

Maximum email size. Larger mails are rejected.

message_rate_limit: <integer> (0 - N) (default = 0)

The maximal number of message delivery requests that any client is allowed to make to this service per minute. To disable this feature, specify a limit of 0.

ndr_on_block: <boolean> (default = 0)

Send out NDR when mail gets blocked

rejectunknown: <boolean> (default = 0)

Reject unknown clients.

rejectunknownsender: <boolean> (default = 0)

Reject unknown senders.

spf: <boolean> (default = 1)

Use Sender Policy Framework.

verifyreceivers: <450 | 550>

Enable receiver verification. The value specifies the numerical reply code when the Postfix SMTP server rejects a recipient address.

4.5.5 Before and After Queue scanning

Scanning email can happen at two different stages of mail-processing:

- During the SMTP Session after the complete message has been received (after the `DATA` command), known as *before queue filtering*.

- After initially accepting the mail and putting it on a queue for further processing, known as *after queue filtering*.

The former has the advantage that the system can reject a mail (by sending a permanent reject code *554*), and leave the task of notifying the original sender to the other mailserver. This is of particular advantage if the processed mail is a spam message or contains a virus and has a forged sender-address. Sending out a notification in this situation leads so-called *backscatter* mail, which might cause your server to get listed as spamming on RBLs.

The latter has the advantage of providing faster delivery of mails for the sending servers, since queueing mails is much faster than analyzing it for spam and viruses.

If a mail is addressed to multiple recipients (e.g. when multiple addresses are subscribed to the same mailinglist) the situation is more complicated: Your mailserver can only reject or accept the mail for all recipients, after having received the complete message, while your rule setup might accept the mail for part of the recipients and reject it for others. This can be due to a complicated rule setup, or if your users use the *User White- and Blacklist* feature.

If the resulting action of the rule system is the same for all recipients Proxmox Mail Gateway responds accordingly if configured for before queue filtering (sending *554* for a blocked mail and *250* for an accepted or quarantined mail). If some mailboxes accept the mail and some reject it the system has to accept the mail.

Whether Proxmox Mail Gateway notifies the sender that delivery failed for some recipients by sending a non-delivery report, depends on the *ndr_on_block* setting in */etc/pmg/pmg.conf*. If enabled an NDR is sent. Keeping it disabled prevents NDRs being sent to the (possibly forged) sender and thus minimizes the chance of getting your IP listed on a RBL. However in certain environments it can be unacceptable not to inform the sender about a rejected mail.

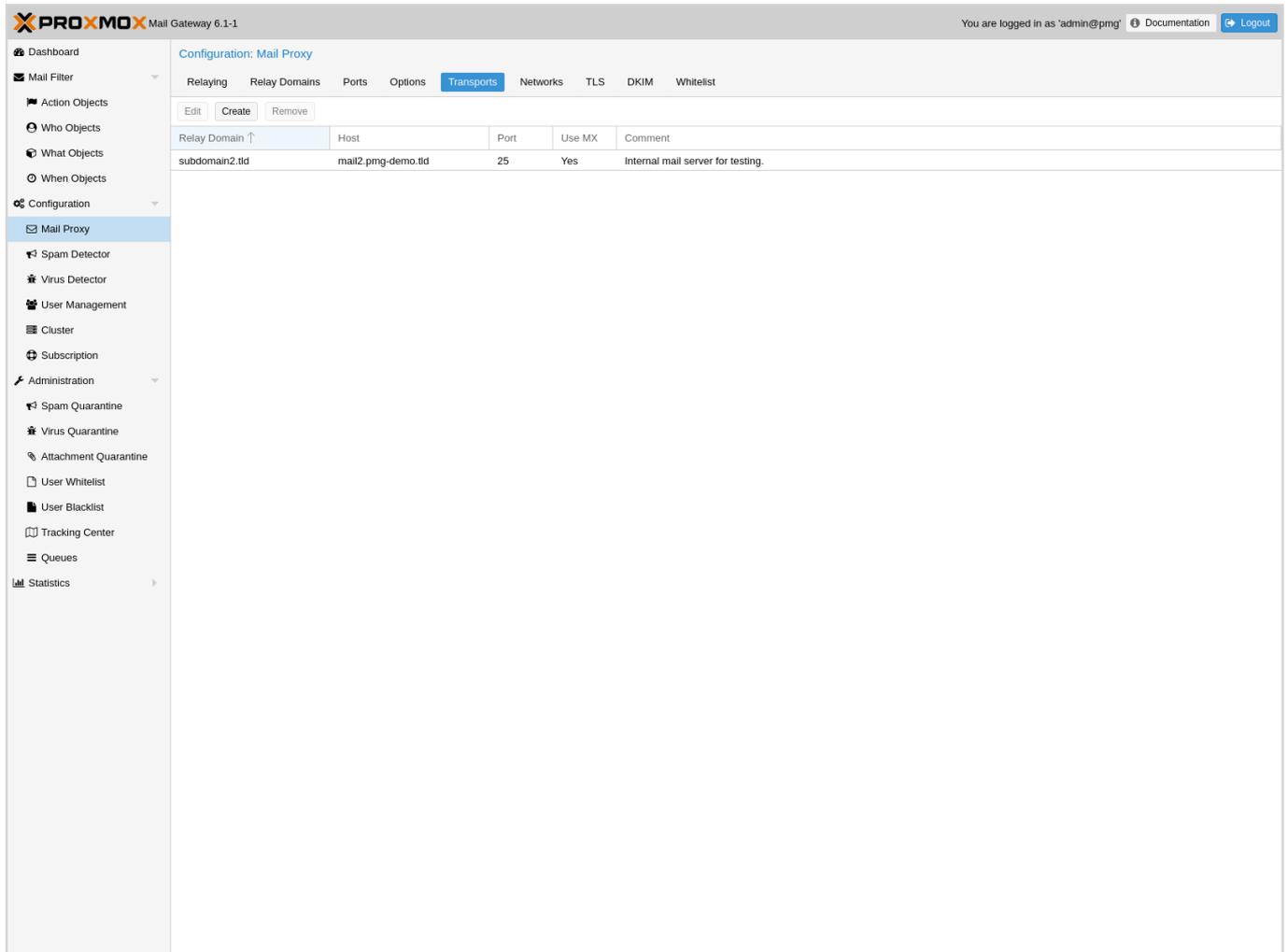
The setting has the same effect if after queue filtering is configured, with the exception that an NDR is always sent out, even if all recipients block the mail, since the mail already got accepted before being analyzed.

The details of integrating the mail proxy with [Postfix](#) in both setups are explained in [Postfix Before-Queue Content Filter](#) and [Postfix After-Queue Content Filter](#) respectively.

Note

Since before queue filtering is currently incompatible with the *Tracking Center* you need to enable it by manually editing */etc/pmg/pmg.conf*.

4.5.6 Transports



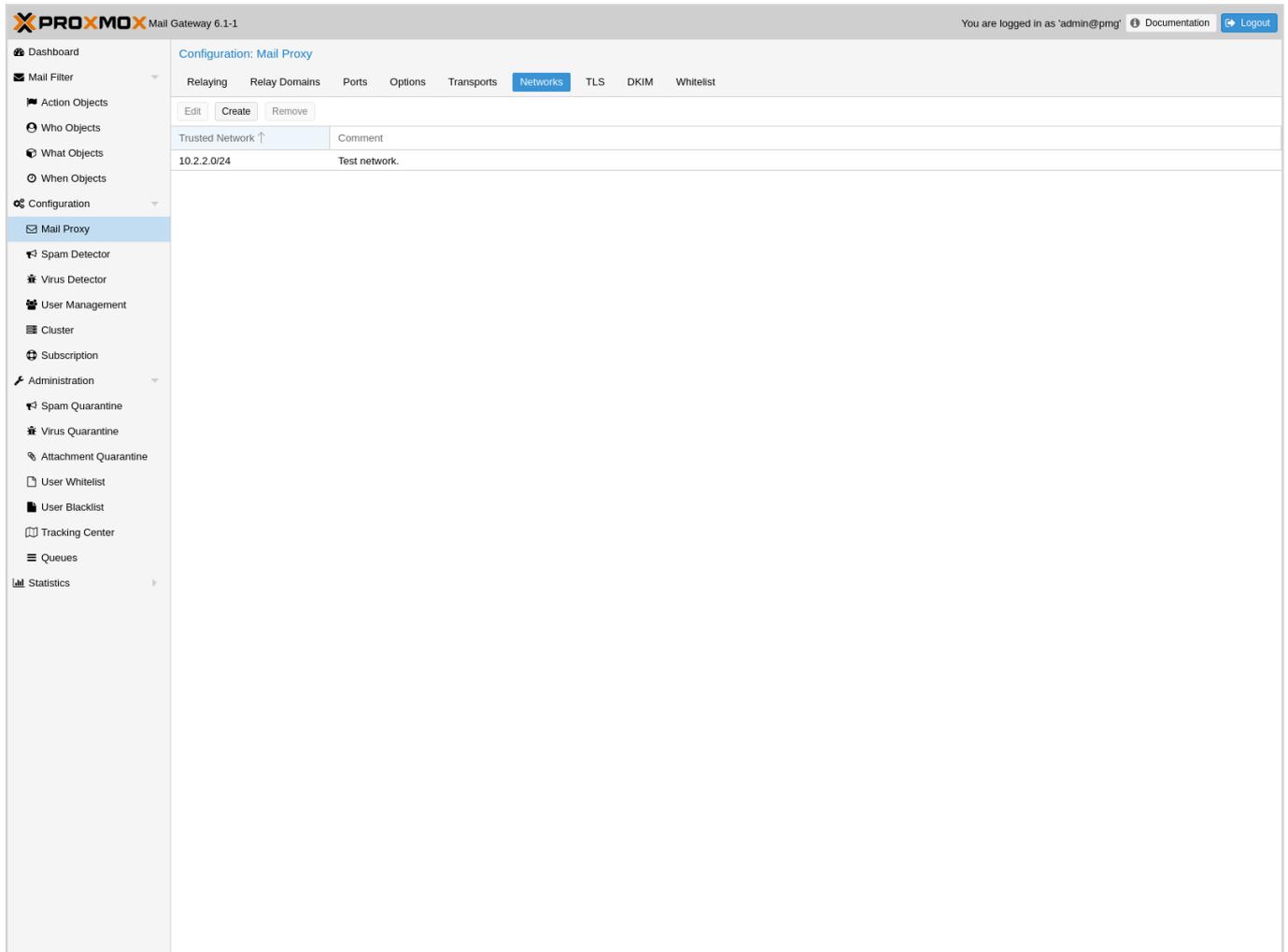
The screenshot displays the Proxmox Mail Gateway administration interface. The top navigation bar shows the Proxmox logo and version 'Mail Gateway 6.1-1'. The user is logged in as 'admin@pmg'. The main content area is titled 'Configuration: Mail Proxy' and has several tabs: Relaying, Relay Domains, Ports, Options, **Transports**, Networks, TLS, DKIM, and Whitelist. The 'Transports' tab is active, showing a table with the following data:

Relay Domain ↑	Host	Port	Use MX	Comment
subdomain2.tld	mail2.pmg-demo.tld	25	Yes	Internal mail server for testing.

You can use Proxmox Mail Gateway to send e-mails to different internal e-mail servers. For example you can send e-mails addressed to domain.com to your first e-mail server, and e-mails addressed to subdomain.domain.com to a second one.

You can add the IP addresses, hostname and SMTP ports and mail domains (or just single email addresses) of your additional e-mail servers.

4.5.7 Networks



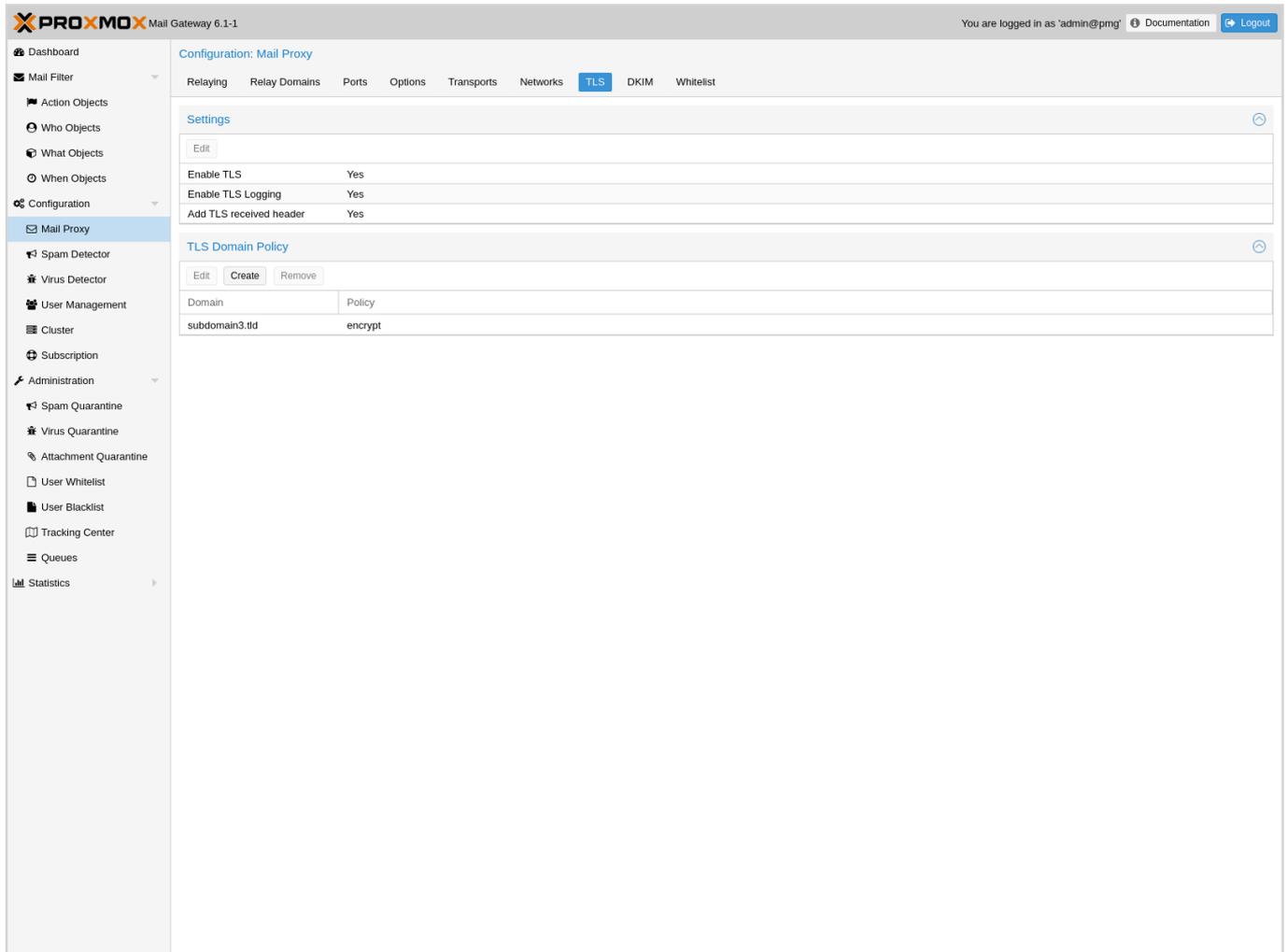
The screenshot shows the Proxmox Mail Gateway administration interface. The top navigation bar includes the Proxmox logo, the version 'Mail Gateway 6.1-1', and the user 'admin@pmg'. The left sidebar contains a menu with categories like 'Mail Filter', 'Configuration', and 'Administration'. The main content area is titled 'Configuration: Mail Proxy' and has a sub-tab 'Networks'. Below the sub-tab are buttons for 'Edit', 'Create', and 'Remove'. A table lists trusted networks with columns for 'Trusted Network' and 'Comment'. One entry is visible: '10.2.2.0/24' with the comment 'Test network.'

You can add additional internal (trusted) IP networks or hosts. All hosts in this list are allowed to relay.

Note

Hosts in the same subnet with Proxmox can relay by default and it's not needed to add them in this list.

4.5.8 TLS



The screenshot shows the Proxmox Mail Gateway administration interface. The top navigation bar includes 'PROXMOX Mail Gateway 6.1-1' and 'You are logged in as 'admin@pmg''. The left sidebar contains a menu with categories like 'Mail Filter', 'Configuration', and 'Administration'. The main content area is titled 'Configuration: Mail Proxy' and has tabs for 'Relaying', 'Relay Domains', 'Ports', 'Options', 'Transports', 'Networks', 'TLS', 'DKIM', and 'Whitelist'. The 'TLS' tab is active, showing two sections: 'Settings' and 'TLS Domain Policy'. The 'Settings' section has an 'Edit' button and a table with three rows: 'Enable TLS' (Yes), 'Enable TLS Logging' (Yes), and 'Add TLS received header' (Yes). The 'TLS Domain Policy' section has 'Edit', 'Create', and 'Remove' buttons and a table with two columns: 'Domain' and 'Policy'. One row is visible with 'subdomain3.tld' in the Domain column and 'encrypt' in the Policy column.

Transport Layer Security (TLS) provides certificate-based authentication and encrypted sessions. An encrypted session protects the information that is transmitted with SMTP mail. When you activate TLS, Proxmox Mail Gateway automatically generates a new self signed certificate for you (`/etc/pmg/pmg-tls.pem`).

Proxmox Mail Gateway uses opportunistic TLS encryption by default. The SMTP transaction is encrypted if the `STARTTLS` ESMTP feature is supported by the remote server. Otherwise, messages are sent in the clear. You can set a different TLS policy per destination domain, should you for example need to prevent e-mail delivery without encryption, or to work around a broken `STARTTLS` ESMTP implementation. See [Postfix TLS Readme](#) for details on the supported policies.

Enable TLS logging

To get additional information about SMTP TLS activity you can enable TLS logging. That way information about TLS sessions and used certificate's is logged via syslog.

Add TLS received header

Set this option to include information about the protocol and cipher used as well as the client and issuer CommonName into the "Received:" message header.

Those settings are saved to subsection `mail` in `/etc/pmg/pmg.conf`, using the following configuration keys:

tls: <boolean> (default = 0)

Enable TLS.

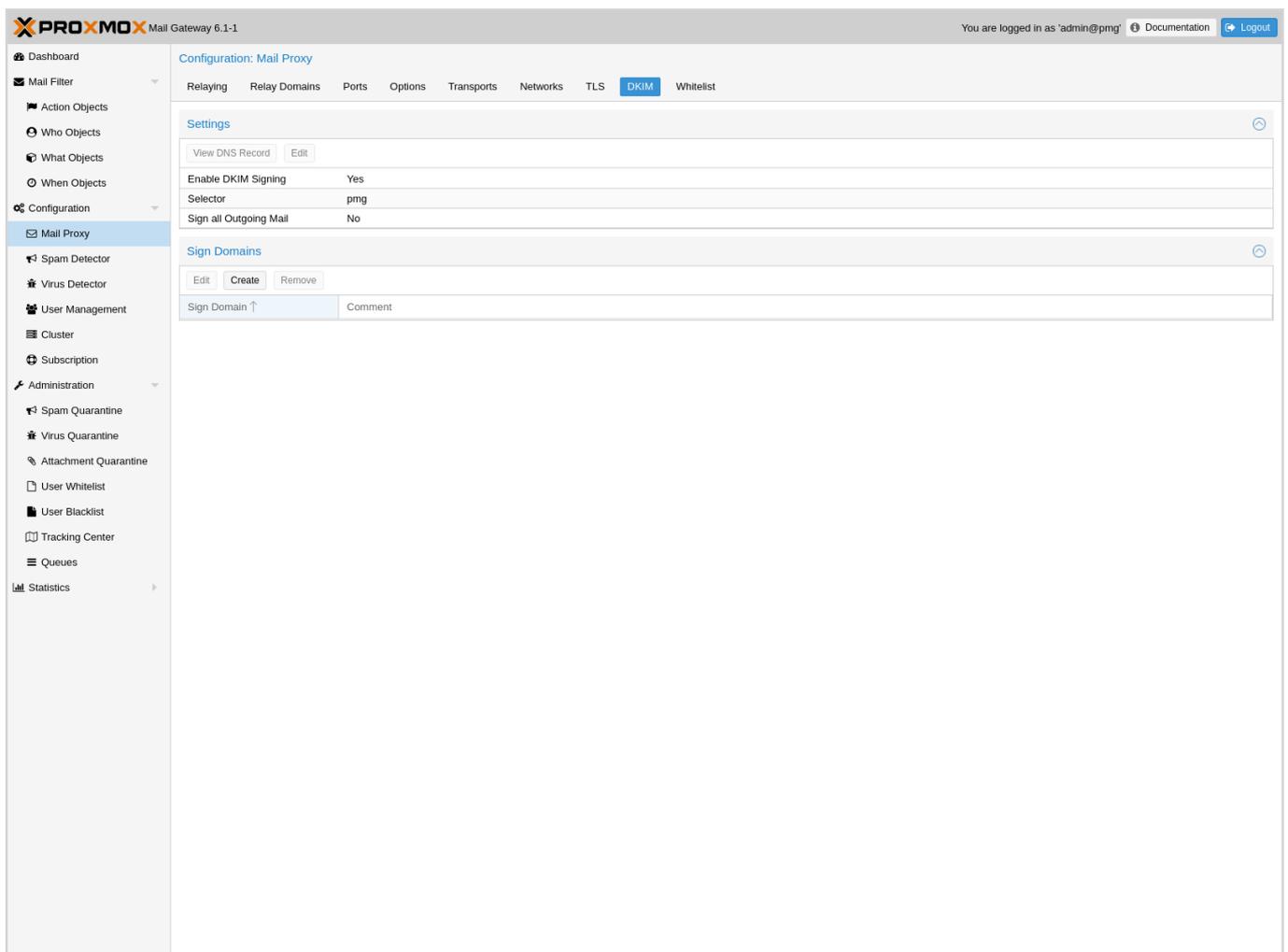
tlsheader: <boolean> (default = 0)

Add TLS received header.

tlslog: <boolean> (default = 0)

Enable TLS Logging.

4.5.9 DKIM Signing



The screenshot shows the Proxmox Mail Gateway 6.1-1 web interface. The top navigation bar includes the Proxmox logo, the version 'Mail Gateway 6.1-1', and the user 'admin@pmg'. The main content area is titled 'Configuration: Mail Proxy' and has several tabs: Relaying, Relay Domains, Ports, Options, Transports, Networks, TLS, DKIM (selected), and Whitelist. The DKIM configuration is shown in two sections: 'Settings' and 'Sign Domains'. The 'Settings' section has a 'View DNS Record' and 'Edit' button, and three rows of configuration: 'Enable DKIM Signing' (Yes), 'Selector' (pmg), and 'Sign all Outgoing Mail' (No). The 'Sign Domains' section has 'Edit', 'Create', and 'Remove' buttons, and a table with columns 'Sign Domain' and 'Comment'.

DomainKeys Identified Mail (DKIM) Signatures (see [RFC 6376](#)) is a method to cryptographically authenticate a mail as originating from a particular domain. Before sending the mail a hash over certain header fields and the body is computed, signed with a private key and added in the `DKIM-Signature` header of the mail. The *selector* (a short identifier chosen by you, used to identify which system and private key were used for signing) is also included in the `DKIM-Signature` header.

The verification is done by the receiver: The public key is fetched via DNS TXT lookup for `yourselector._domainkey.yourdomain.com` and used for verifying the hash. You can publish multiple selectors for your domain, each use by a system which sends e-mail from your domain, without the need to share the private key.

Proxmox Mail Gateway verifies DKIM Signatures for inbound mail in the Spam Filter by default.

Additionally it supports conditionally signing outbound mail if configured. It uses one private key and selector per PMG deployment (all nodes in a cluster use the same key). The key has a minimal size of 1024 bits and `rsa-sha256` is used as signing algorithm.

The headers included in the signature are taken from the list of `Mail::DKIM::Signer`. Additionally `Content-Type` (if present), `From`, `To`, `CC`, `Reply-To` and `Subject` get oversigned.

You can either sign all mails received on the internal port using the domain of the envelope sender address or create a list of domains, for which e-mails should be signed, defaulting to the list of relay domains.

Enable DKIM Signing

Controls whether outbound mail should get DKIM signed.

Selector

The selector used for signing the mail. The private key used for signing is saved under `/etc/pmg/dkim/selector`.

You can display the DNS TXT record which you need to add to all domains signed by Proxmox Mail Gateway by clicking on the *View DNS Record* Button.

Sign all Outgoing Mail

Controls whether all outbound mail should get signed or only mails from domains listed in `/etc/pmg/dkim/domains` if it exists and `/etc/pmg/domains` otherwise.

Those settings are saved to subsection `admin` in `/etc/pmg/pmg.conf`, using the following configuration keys:

`dkim_selector: <string>`

Default DKIM selector

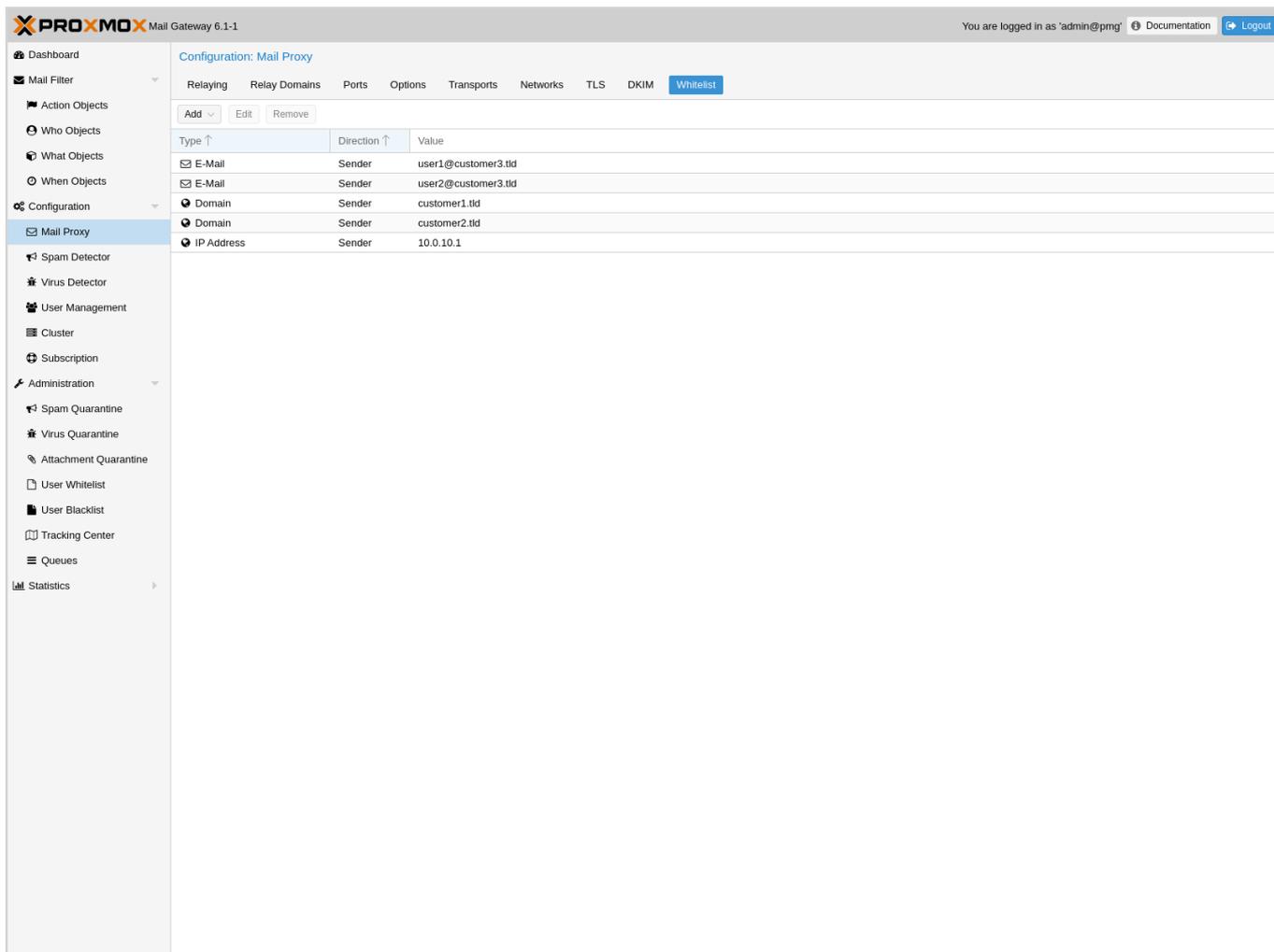
`dkim_sign: <boolean> (default = 0)`

DKIM sign outbound mails with the configured Selector.

`dkim_sign_all_mail: <boolean> (default = 0)`

DKIM sign all outgoing mails irrespective of the Envelope From domain.

4.5.10 Whitelist



The screenshot shows the Proxmox Mail Gateway administration interface. The top navigation bar includes the Proxmox logo, the version 'Mail Gateway 6.1-1', and the user 'admin@pmg'. The left sidebar contains a menu with categories like Mail Filter, Configuration, and Administration. The main content area is titled 'Configuration: Mail Proxy' and has tabs for Relaying, Relay Domains, Ports, Options, Transports, Networks, TLS, DKIM, and Whitelist. The Whitelist tab is active, showing a table with columns for Type, Direction, and Value. The table contains five entries: two E-Mail entries, two Domain entries, and one IP Address entry.

Type ↑	Direction ↑	Value
E-Mail	Sender	user1@customer3.tld
E-Mail	Sender	user2@customer3.tld
Domain	Sender	customer1.tld
Domain	Sender	customer2.tld
IP Address	Sender	10.0.10.1

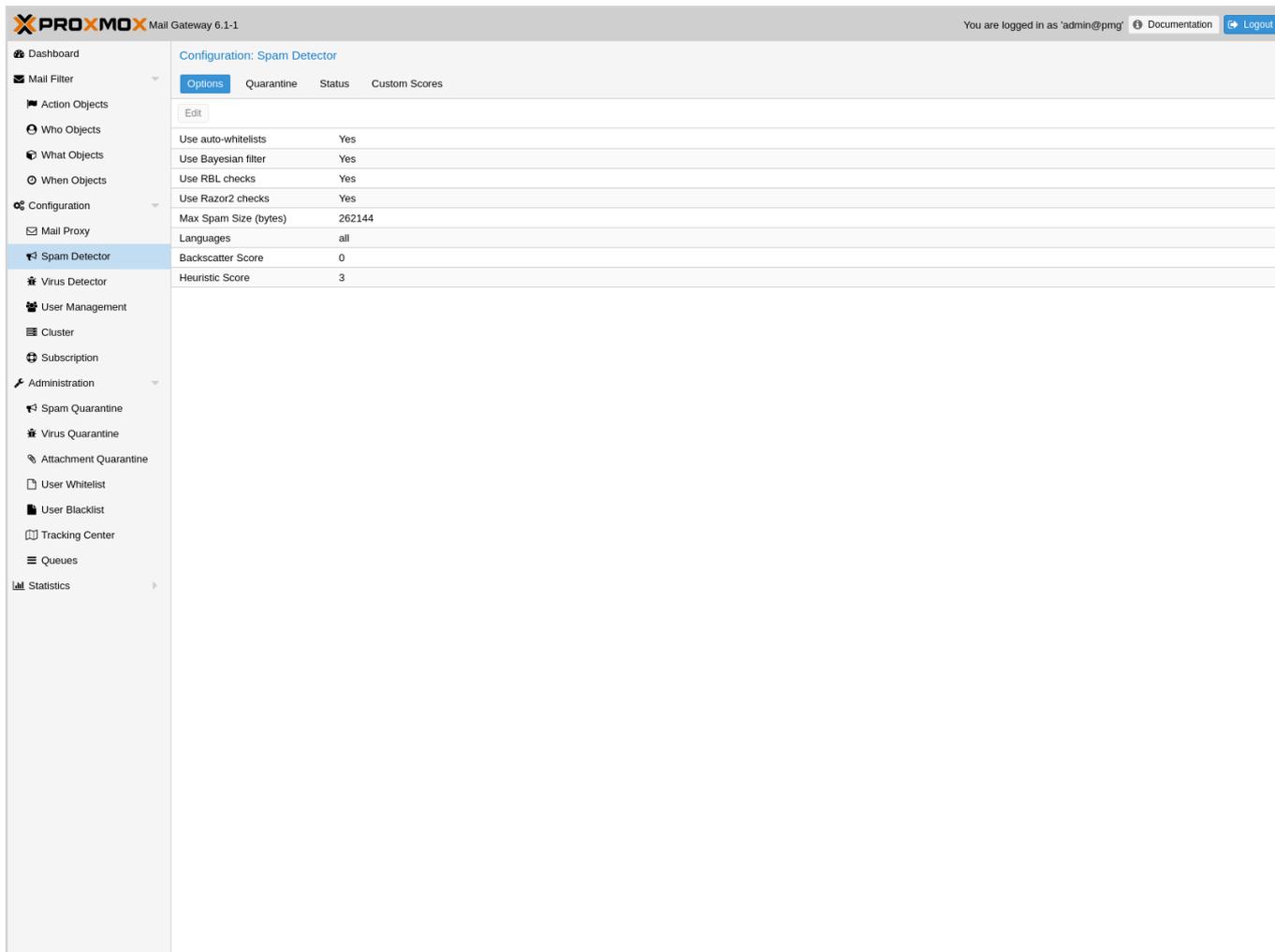
All SMTP checks are disabled for those entries (e. g. Greylisting, SPF, RBL, ...)

Note

If you use a backup MX server (e.g. your ISP offers this service for you) you should always add those servers here.

4.6 Spam Detector Configuration

4.6.1 Options



Configuration: Spam Detector	
Edit	
Use auto-whitelists	Yes
Use Bayesian filter	Yes
Use RBL checks	Yes
Use Razor2 checks	Yes
Max Spam Size (bytes)	262144
Languages	all
Backscatter Score	0
Heuristic Score	3

Proxmox Mail Gateway uses a wide variety of local and network tests to identify spam signatures. This makes it harder for spammers to identify one aspect which they can craft their messages to work around the spam filter.

Every single e-mail will be analyzed and gets a spam score assigned. The system attempts to optimize the efficiency of the rules that are run in terms of minimizing the number of false positives and false negatives.

bounce_score: <integer> (0 - 1000) (default = 0)

Additional score for bounce mails.

clamav_heuristic_score: <integer> (0 - 1000) (default = 3)

Score for ClamAV heuristics (Encrypted Archives/Documents, Google Safe Browsing database, PhishingScanURLs, ...).

languages: (all|([a-z][a-z])+([a-z][a-z])*) (default = all)

This option is used to specify which languages are considered OK for incoming mail.

maxspamsize: <integer> (64 - N) (default = 262144)

Maximum size of spam messages in bytes.

rbl_checks: <boolean> (default = 1)

Enable real time blacklists (RBL) checks.

use_awl: <boolean> (default = 1)

Use the Auto-Whitelist plugin.

use_bayes: <boolean> (default = 1)

Whether to use the naive-Bayesian-style classifier.

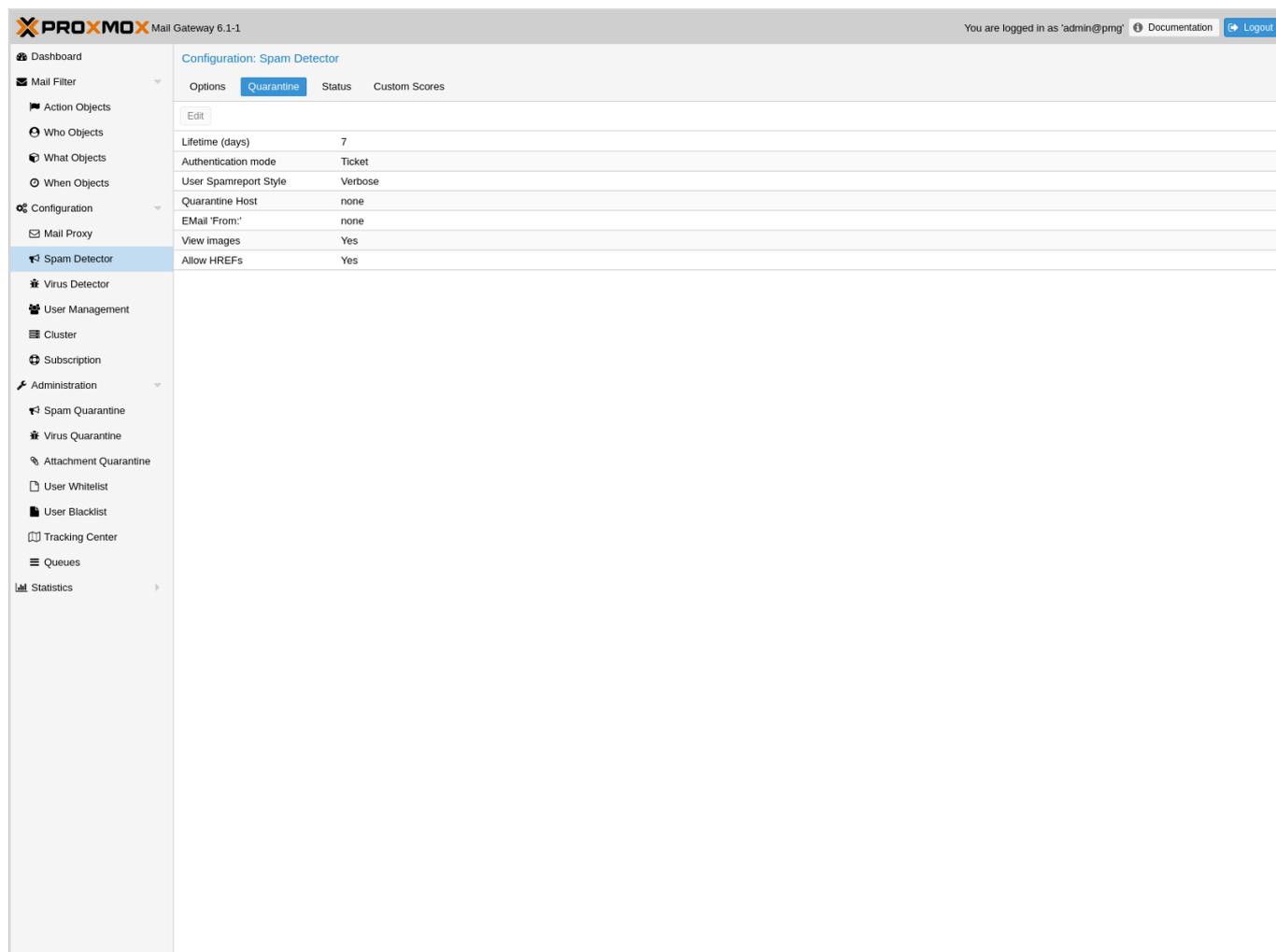
use_razor: <boolean> (default = 1)

Whether to use Razor2, if it is available.

wl_bounce_relays: <string>

Whitelist legitimate bounce relays.

4.6.2 Quarantine



The screenshot shows the Proxmox Mail Gateway 6.1-1 web interface. The top navigation bar includes the Proxmox logo, the version 'Mail Gateway 6.1-1', and the user 'admin@pmg' with links for 'Documentation' and 'Logout'. The left sidebar contains a navigation menu with categories like 'Mail Filter', 'Configuration', 'Administration', and 'Statistics'. The main content area is titled 'Configuration: Spam Detector' and has tabs for 'Options', 'Quarantine', 'Status', and 'Custom Scores'. The 'Quarantine' tab is selected, displaying a table of configuration settings.

Option	Value
Lifetime (days)	7
Authentication mode	Ticket
User Spamreport Style	Verbose
Quarantine Host	none
E-Mail 'From:'	none
View images	Yes
Allow HREFs	Yes

Proxmox analyses all incoming e-mail messages and decides for each e-mail if its ham or spam (or virus). Good e-mails are delivered to the inbox and spam messages can be moved into the spam quarantine.

The system can be configured to send daily reports to inform users about the personal spam messages received the last day. That report is only sent if there are new messages in the quarantine.

Some options are only available in the config file `/etc/pmg/pmg.conf`, and not in the webinterface.

allowhrefs: <boolean> (*default = 1*)

Allow to view hyperlinks.

authmode: <ldap | ldapticket | ticket> (*default = ticket*)

Authentication mode to access the quarantine interface. Mode *ticket* allows login using tickets sent with the daily spam report. Mode *ldap* requires to login using an LDAP account. Finally, mode *ldapticket* allows both ways.

hostname: <string>

Quarantine Host. Useful if you run a Cluster and want users to connect to a specific host.

lifetime: <integer> (1 - N) (*default = 7*)

Quarantine life time (days)

mailfrom: <string>

Text for *From* header in daily spam report mails.

port: <integer> (1 - 65535) (*default = 8006*)

Quarantine Port. Useful if you have a reverse proxy or port forwarding for the webinterface. Only used for the generated Spam report.

protocol: <http | https> (*default = https*)

Quarantine Webinterface Protocol. Useful if you have a reverse proxy for the webinterface. Only used for the generated Spam report.

reportstyle: <custom | none | short | verbose> (*default = verbose*)

Spam report style.

viewimages: <boolean> (*default = 1*)

Allow to view images.

4.6.3 Customization of Rulescores

Configuration: Spam Detector

Options Quarantine Status **Custom Scores**

Edit Create Remove Revert Apply Custom Scores

Name ↑	Score	Comment
DEAR_SOMETHING	0.000	disable
URIBL_BLACK	2.100	increase by 0.3

Pending changes (Please restart pmg-smtp-filter to activate changes)

```

--- /etc/mail/spamassassin/pmg-scores.cf      2019-11-19 13:42:17.057134696 +0000
+++ /var/cache/pmg-scores.cf                 2019-11-19 15:14:17.410909840 +0000
@@ -0,0 +1,4 @@
+# disable
+score DEAR_SOMETHING 0.000
+# increase by 0.3
+score URIBL_BLACK 2.100

```

While the default scoring of **SpamAssassin™**'s ruleset provides very good detection rates, sometimes your particular environment can benefit from slightly adjusting the score of a particular rule. Two examples:

- Your system receives spam mails which are scored at 4.9 and you have a rule which puts all mails above 5 in the quarantine. The one thing the spam mails have in common is that they all hit *URIBL_BLACK*. By increasing the score of this rule by 0.2 points the spam mails would all be quarantined instead of being sent to your users
- Your system tags many legitimate mails from a partner organization as spam, because the organization has a policy that each mail has to start with *Dear madam or sir* (generating 1.9 points through the rule *DEAR_SOMETHING*). By setting the score of this rule to 0 you can disable it completely.

The system logs all rules which particular mail hits. Analyzing the logs can lead to finding such a pattern in your environment.

You can adjust the score of a rule by creating a new *Custom Rule Score* entry in the GUI.

Note

In general it is strongly recommended to not make large changes to the default scores.

4.7 Virus Detector Configuration

4.7.1 Options

The screenshot shows the Proxmox Mail Gateway 6.1-1 web interface. The top navigation bar includes the Proxmox logo, the version number, and a user login status. The left sidebar contains a menu with categories like Mail Filter, Configuration, and Administration. The main content area is titled 'Configuration: Virus Detector' and has three tabs: 'Options', 'ClamAV', and 'Quarantine'. The 'Options' tab is selected, displaying a table of configuration parameters:

Parameter	Value
Block encrypted archives and documents	No
Max recursion	5
Max files	1000
Max file size	25000000
Max scan size	100000000
Max credit card numbers	0

All mails are automatically passed to the included virus detector (**ClamAV®**). The default settings are considered safe, so it is usually not required to change them.

ClamAV® related settings are saved to subsection `clamav` in `/etc/pmg/pmg.conf`, using the following configuration keys:

archiveblockencrypted: <boolean> (default = 0)

Whether to mark encrypted archives and documents as heuristic virus match. A match does not necessarily result in an immediate block, it just raises the Spam Score by `clamav_heuristic_score`.

archivemaxfiles: <integer> (0 - N) (default = 1000)

Number of files to be scanned within an archive, a document, or any other kind of container. Warning: disabling this limit or setting it too high may result in severe damage to the system.

archivemaxrec: <integer> (1 - N) (default = 5)

Nested archives are scanned recursively, e.g. if a ZIP archive contains a TAR file, all files within it will also be scanned. This option specifies how deeply the process should be continued. Warning: setting this limit too high may result in severe damage to the system.

archivemaxsize: <integer> (1000000 - N) (default = 25000000)

Files larger than this limit (in bytes) won't be scanned.

dbmirror: <string> (default = database.clamav.net)

ClamAV database mirror server.

maxcccount: <integer> (0 - N) (default = 0)

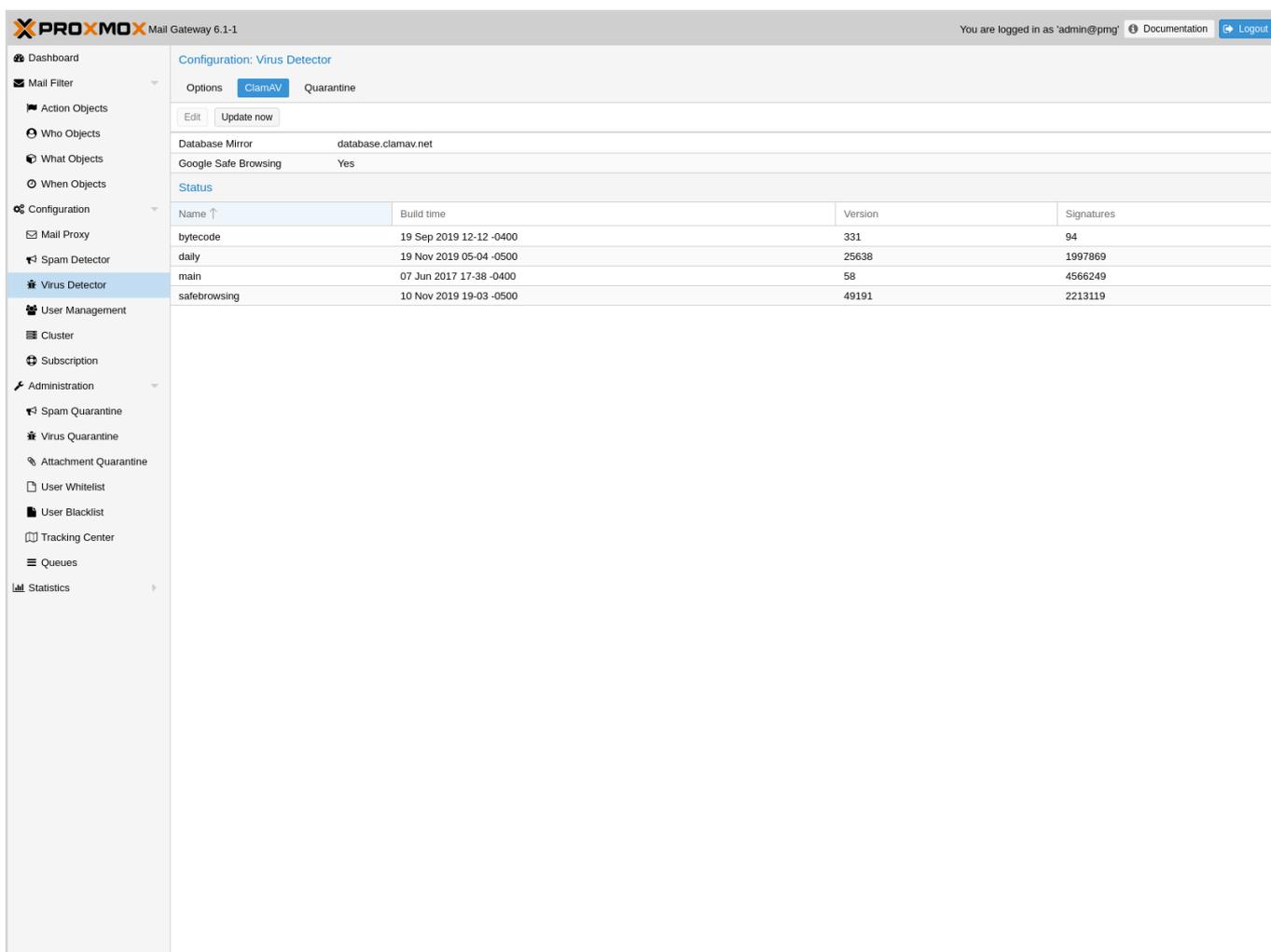
This option sets the lowest number of Credit Card or Social Security numbers found in a file to generate a detect.

maxscansize: <integer> (1000000 - N) (default = 100000000)

Sets the maximum amount of data (in bytes) to be scanned for each input file.

safebrowsing: <boolean> (default = 1)

Enables support for Google Safe Browsing.



The screenshot shows the Proxmox Mail Gateway 6.1-1 GUI. The main content area is titled "Configuration: Virus Detector" and has tabs for "Options", "ClamAV", and "Quarantine". The "ClamAV" tab is active, showing the following configuration:

- Database Mirror: database.clamav.net
- Google Safe Browsing: Yes

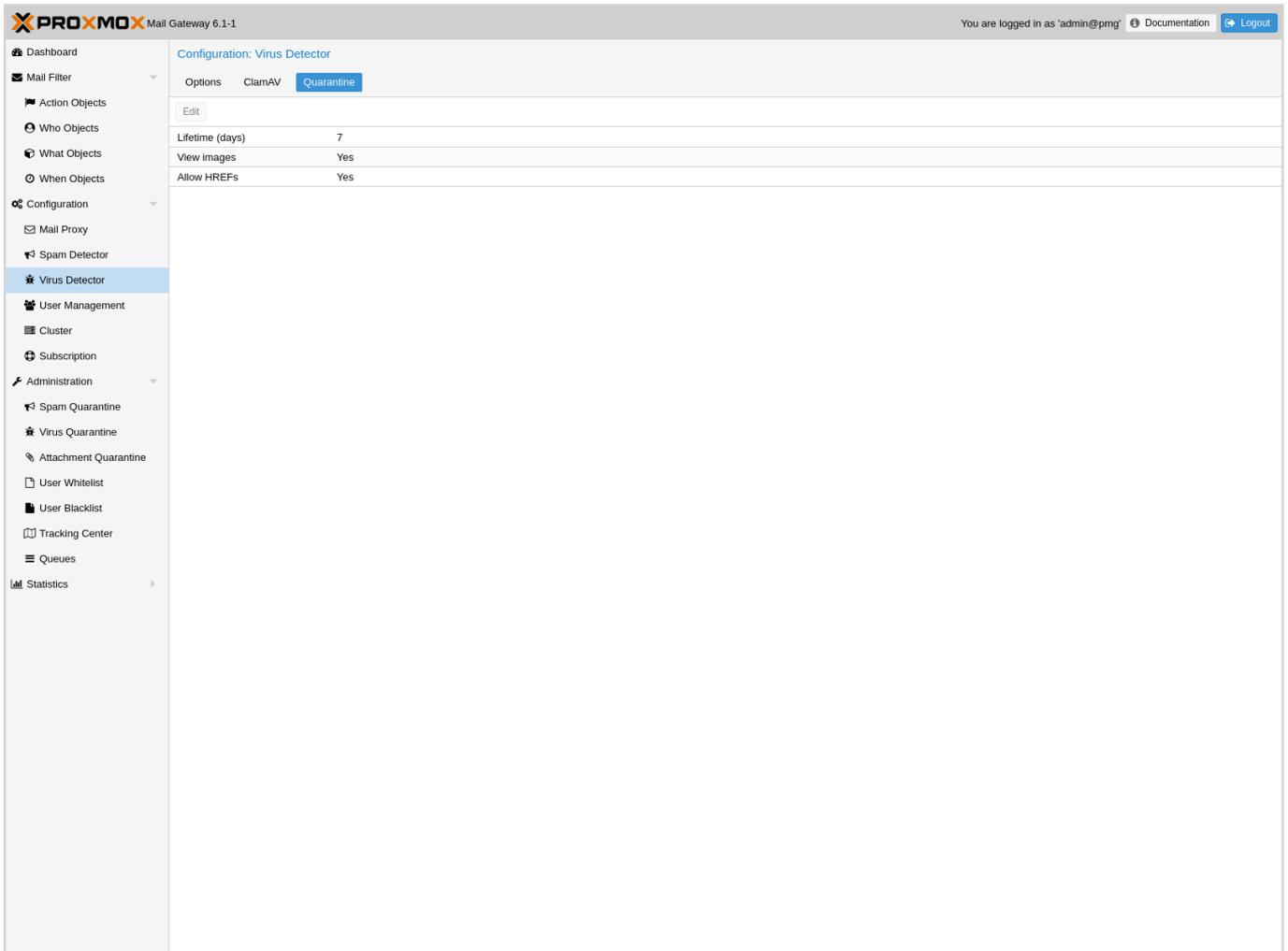
Below the configuration is a "Status" section with a table of virus signature databases:

Name ↑	Build time	Version	Signatures
bytecode	19 Sep 2019 12-12 -0400	331	94
daily	19 Nov 2019 05-04 -0500	25638	1997869
main	07 Jun 2017 17-38 -0400	58	4566249
safebrowsing	10 Nov 2019 19-03 -0500	49191	2213119

The left sidebar contains navigation menus for Dashboard, Mail Filter, Action Objects, Who Objects, What Objects, When Objects, Configuration, Mail Proxy, Spam Detector, Virus Detector (selected), User Management, Cluster, Subscription, Administration, Spam Quarantine, Virus Quarantine, Attachment Quarantine, User Whitelist, User Blacklist, Tracking Center, Queues, and Statistics.

Please note that the virus signature database is automatically updated. But you can see the database status on the GUI, and you can trigger manual updates there.

4.7.2 Quarantine



Identified virus mails are automatically moved to the virus quarantine. The administrator can view those mails using the GUI, or deliver them in case of false positives. Proxmox Mail Gateway does not notify individual users about received virus mails.

Virus quarantine related settings are saved to subsection *virusquar* in `/etc/pmg/pmg.conf`, using the following configuration keys:

allowhrefs: <boolean> (*default = 1*)

Allow to view hyperlinks.

lifetime: <integer> (1 - N) (*default = 7*)

Quarantine life time (days)

viewimages: <boolean> (*default = 1*)

Allow to view images.

4.8 Custom SpamAssassin configuration

This is only for advanced users. SpamAssassin™'s rules and their associated scores get updated regularly and are trained on a huge corpus, which gets classified by experts. In most cases adding a rule for matching

a particular keyword is the wrong approach, leading to many false positives. Usually bad detection rates are better addressed by properly setting up DNS than by adding a custom rule - watch out for matches to `URIBL_BLOCKED` in the logs or spam-headers - see the [SpamAssassin DNSBL documentation](#).

To add or change the Proxmox SpamAssassin™ configuration please login to the console via SSH. Change to the `/etc/mail/spamassassin/` directory. In this directory there are several files (`init.pre`, `local.cf`, ...) - do not change them, as `init.pre`, `v310.pre`, `v320.pre`, `local.cf` will be overwritten by the [template engine](#) Section 4.3, while the others can get updated by any SpamAssassin™ package upgrade.

To add your special configuration, you have to create a new file and name it `custom.cf` (in this directory), then add your configuration there. Make sure to use the correct SpamAssassin™ syntax, and test with

```
# spamassassin -D --lint
```

If you run a cluster, the `custom.cf` file is synchronized from the master node to all cluster members automatically.

Should you only wish to adjust the score assigned to a particular rule you can also use the [Custom Rule Score](#) Section 4.6.3 settings in the GUI.

4.9 Custom Check Interface

For use cases which are not handled by the Proxmox Mail Gateway Virus Detector and SpamAssassin™ configuration, advanced users can create a custom check executable which, if enabled will be called before the Virus Detector and before passing an e-mail through the Rule System. The custom check API is kept as simple as possible, while still providing a great deal of control over the treatment of an e-mail. Its input is passed via two CLI arguments:

- the *api-version* (currently `v1`) - for potential future change of the invocation
- the *queue-file-name* - a filename, which contains the complete e-mail as `rfc822/eml` file

The expected output need to be printed on STDOUT and consists of two lines:

- the *api-version* (currently `v1`) - see above
- one of the following 3 results:
 - *OK* - e-mail is ok
 - *VIRUS: <virusdescription>* - e-mail is treated as if it contained a virus (the `virusdescription` is logged and added to the e-mail's headers)
 - *SCORE: <number>* - `<number>` is added (negative numbers are also possible) to the e-mail's spam-score

The check is run with a 5 minute timeout - if it is exceeded the check executable is killed and the e-mail is treated as OK.

All output written to STDERR by the check is written with priority `err` to the journal/mail.log.

A simple sample script following the API (and yielding a random result) for reference:

```
#!/bin/sh

echo "called with $*" 1>&2

if [ "$#" -ne 2 ]; then
    echo "usage: $0 APIVERSION QUEUEFILENAME" 1>&2
    exit 1
fi

apiver="$1"
shift

if [ "$apiver" != "v1" ]; then
    echo "wrong APIVERSION: $apiver" 1>&2
    exit 2
fi

queue_file="$1"

echo "v1"

choice=$(shuf -i 0-3 -n1)

case "$choice" in
    0)
        echo OK
        ;;
    1)
        echo SCORE: 4
        ;;
    2)
        echo VIRUS: Random Virus
        ;;
    3) #timeout-test
        for i in $(seq 1 7); do
            echo "custom checking mail: $queue_file - minute $i" 1>&2
            sleep 60
        done
        ;;
esac

exit 0
```

The custom check needs to be enabled in the admin section of `/etc/pmg/pmg.conf`

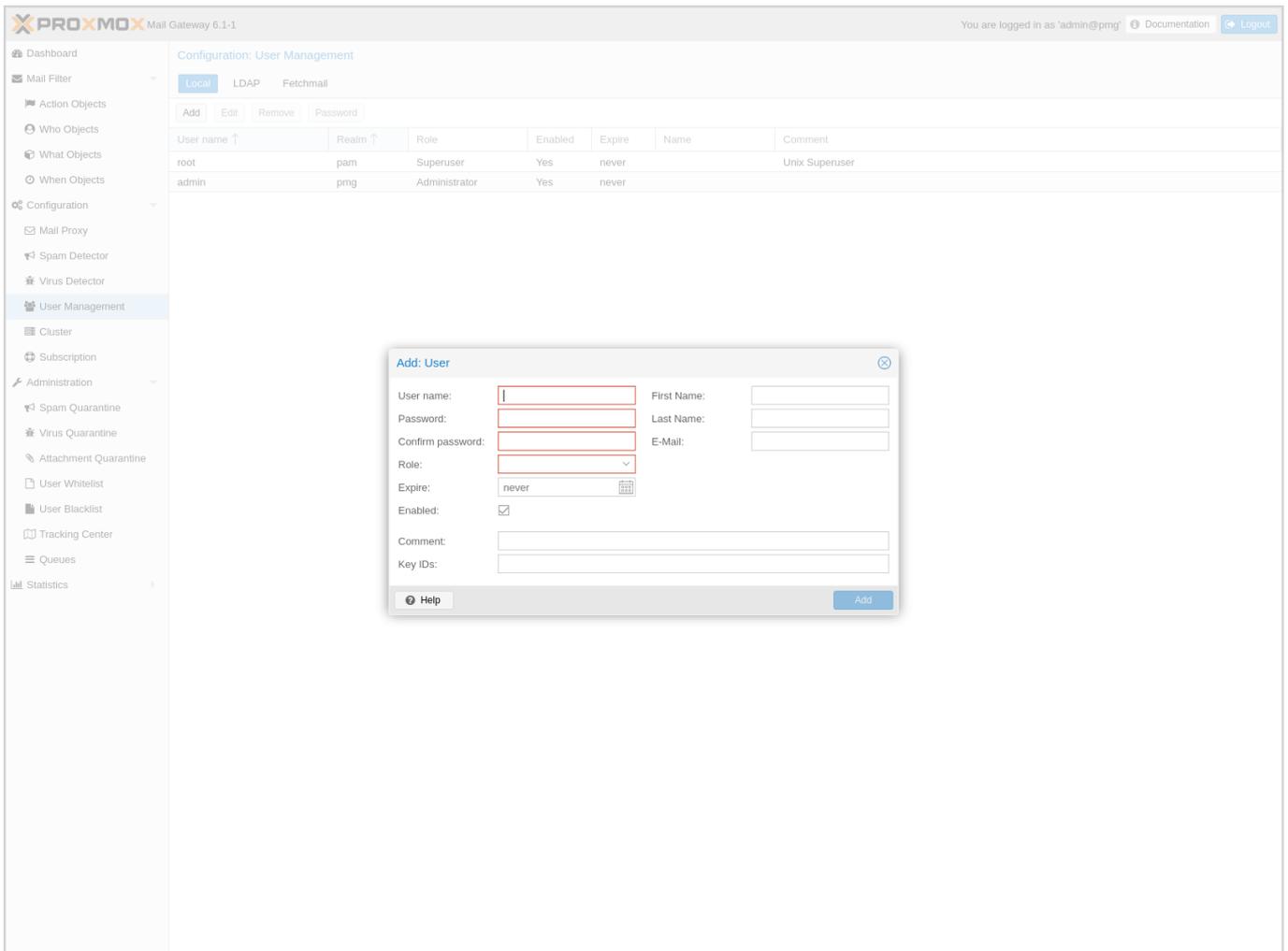
```
section: admin
    custom_check 1
```

The location of the custom check executable can also be set there with the key `custom_check_path` and defaults to `/usr/local/bin/pmg-custom-check`.

4.10 User Management

User management in Proxmox Mail Gateway consists of three types of users/accounts:

4.10.1 Local Users



The screenshot shows the Proxmox Mail Gateway 6.1-1 web interface. The main content area is titled "Configuration: User Management" and has tabs for "Local", "LDAP", and "Fetchmail". Below the tabs are buttons for "Add", "Edit", "Remove", and "Password". A table lists the current local users:

User name ↑	Realm ↑	Role	Enabled	Expire	Name	Comment
root	pam	Superuser	Yes	never		Unix Superuser
admin	pmg	Administrator	Yes	never		

An "Add: User" dialog box is open in the foreground, containing the following fields:

- User name:
- Password:
- Confirm password:
- Role:
- Expire:
- Enabled:
- Comment:
- Key IDs:
- First Name:
- Last Name:
- E-Mail:

Buttons for "Help" and "Add" are visible at the bottom of the dialog.

Local users are used to manage and audit Proxmox Mail Gateway. Those users can login on the management web interface.

There are three roles:

- **Administrator**
Is allowed to manage settings of Proxmox Mail Gateway, except some tasks like network configuration and upgrading.
- **Quarantine manager**
Is allowed to manage quarantines, blacklists and whitelists, but not other settings. Has no right to view any other data.
- **Auditor**
With this role, the user is only allowed to view data and configuration, but not to edit it.

In addition there is always the *root* user, which is used to perform special system administrator tasks, such as upgrading a host or changing the network configuration.

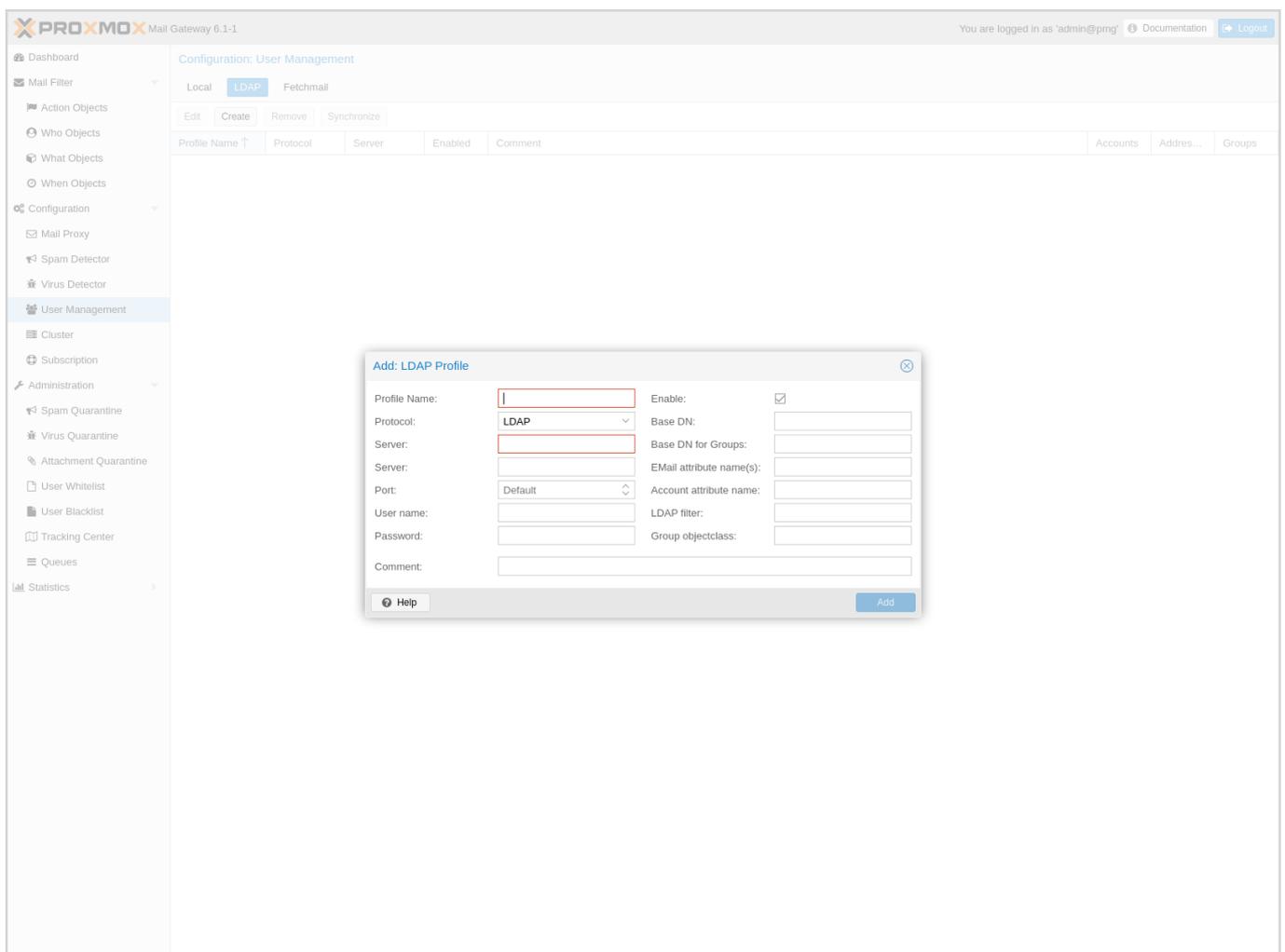
Note

Only pam users are able to login via the webconsole and ssh, which the users created with the web interface are not. Those users are created for Proxmox Mail Gateway administration only.

Local user related settings are saved in `/etc/pmg/user.conf`.

For details of the fields see [user.conf](#) Section [E.3](#)

4.10.2 LDAP/Active Directory



You can specify multiple LDAP/Active Directory profiles, so that you can create rules matching those users and groups.

Creating a profile requires (at least) the following:

- profile name
- protocol (LDAP or LDAPS; LDAPS is recommended)
- at least one server

- a user and password (if your server does not support anonymous binds)

All other fields should work with the defaults for most setups, but can be used to customize the queries.

The settings are saved to `/etc/pmg/ldap.conf`. Details for the options can be found here: [ldap.conf](#) Section [E.4](#)

Bind user

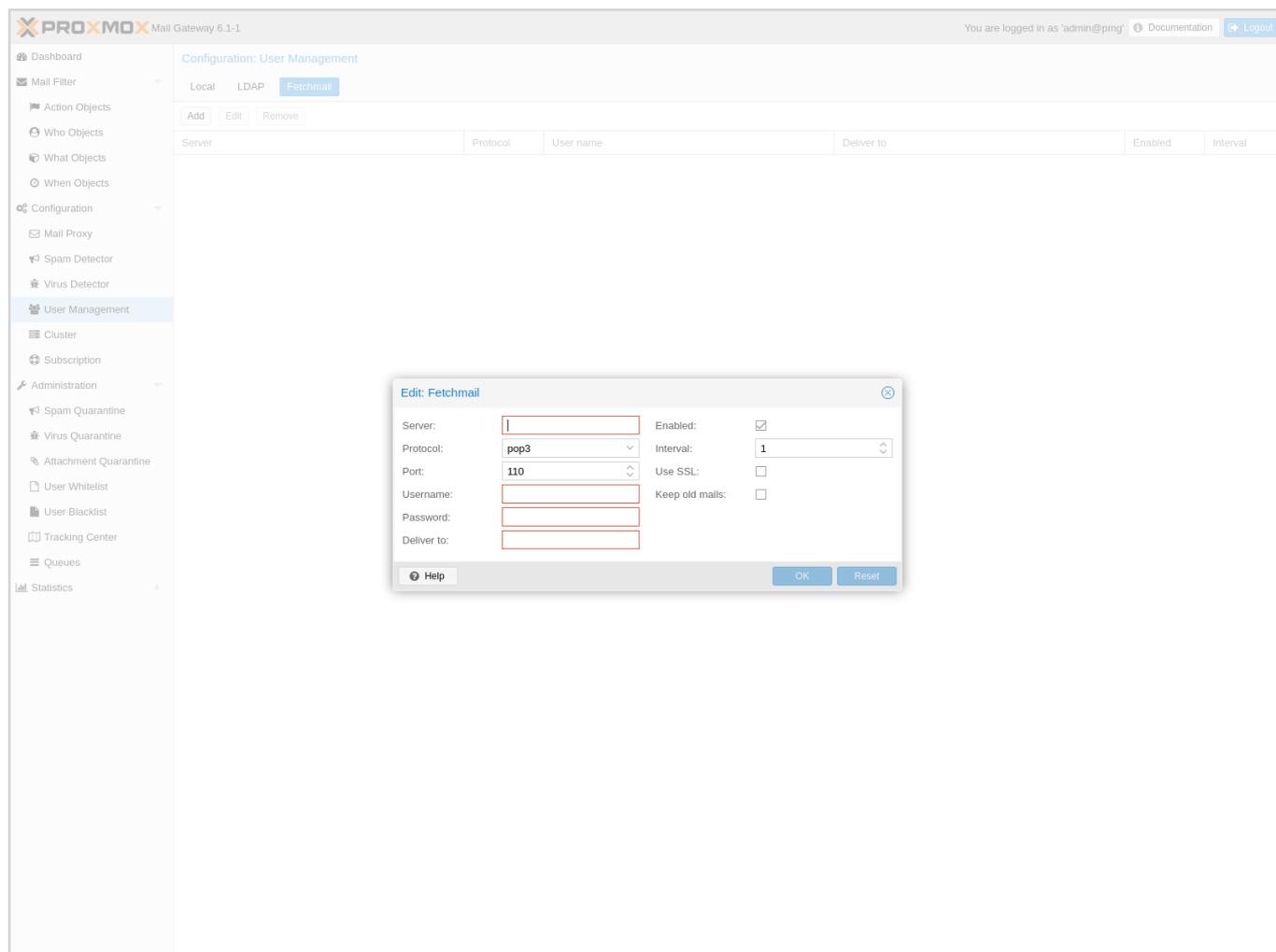
It is highly recommended that the user which you use for connecting to the LDAP server only has the permission to query the server. For LDAP servers (for example OpenLDAP or FreeIPA), the username has to be of a format like `uid=username,cn=users,cn=accounts,dc=domain`, where the specific fields are depending on your setup. For Active Directory servers, the format should be like `username@domain` or `domain\username`.

Sync

Proxmox Mail Gateway synchronizes the relevant user and group info periodically, so that that information is available in a fast manner, even when the LDAP/AD server is temporarily not accessible.

After a successful sync, the groups and users should be visible on the web interface. After that, you can create rules targeting LDAP users and groups.

4.10.3 Fetchmail



Fetchmail is utility for polling and forwarding e-mails. You can define e-mail accounts, which will then be fetched and forwarded to the e-mail address you defined.

You have to add an entry for each account/target combination you want to fetch and forward. Those will then be regularly polled and forwarded, according to your configuration.

The API and web interface offer following configuration options:

enable: <boolean> (**default = 0**)

Flag to enable or disable polling.

interval: <integer> (**1 - 2016**)

Only check this site every <interval> poll cycles. A poll cycle is 5 minutes.

keep: <boolean> (**default = 0**)

Keep retrieved messages on the remote mailserver.

pass: <string>

The password used tfor server login.

port: <integer> (1 - 65535)

Port number.

protocol: <imap | pop3>

Specify the protocol to use when communicating with the remote mailserv

server: <string>

Server address (IP or DNS name).

ssl: <boolean> (default = 0)

Use SSL.

target: (? : [^\s\/\\@]+\@[^\s\/\\@]+)

The target email address (where to deliver fetched mails).

user: <string>

The user identification to be used when logging in to the server

Chapter 5

Rule-Based Mail Filter

Proxmox Mail Gateway ships with a highly configurable mail filter. It's an easy but powerful way to define filter rules by user, domains, time frame, content type and resulting action.

The screenshot shows the Proxmox Mail Gateway 6.1-1 web interface. The main content area displays a table of rules under the 'Rules' tab. The 'Blacklist' rule is selected, and its configuration is shown in a right-hand panel. The table lists various rules with their names, priorities, and directions. The right-hand panel shows the configuration for the 'Blacklist' rule, including its priority (98), direction (In), and active status (Yes). Below the rule configuration, there are sections for 'Used Objects' and 'Available Objects', each with a list of objects to be applied to the rule.

Name	Priority	Direction
Blacklist	98	In
Block Viruses	96	In
Virus Alert	96	Out
Block Dangerous Files	93	In
Modify Header	90	In
Quarantine Office Files	89	In
Block Multimedia Files	87	In & Out
Whitelist	85	In
Block Spam (Level 10)	82	In
Quarantine/Mark Spam (Level 5)	81	In
Quarantine/Mark Spam (Level 3)	80	In
Block outgoing Spam	70	Out
Add Disclaimer	60	Out

Every rule has 5 categories (*FROM*, *TO*, *WHEN*, *WHAT* and *ACTION*), and each category may contain several objects to match certain criteria:

Who - objects

Who is the sender or receiver of the e-mail? Those objects can be used for the *TO* and/or *FROM* category.

Example: EMail-object - Who is the sender or receiver of the e-mail?

What - objects

What is in the e-mail?

Example: Does the e-mail contain spam?

When - objects

When is the e-mail received by Proxmox Mail Gateway?

Example: Office Hours - Mail is received between 8:00 and 16:00.

Action - objects

Defines the final actions.

Example: Mark e-mail with "SPAM:" in the subject.

Rules are ordered by priority, so rules with higher priority are executed first. It is also possible to set a processing direction:

In

Rule applies for all incoming e-mails

Out

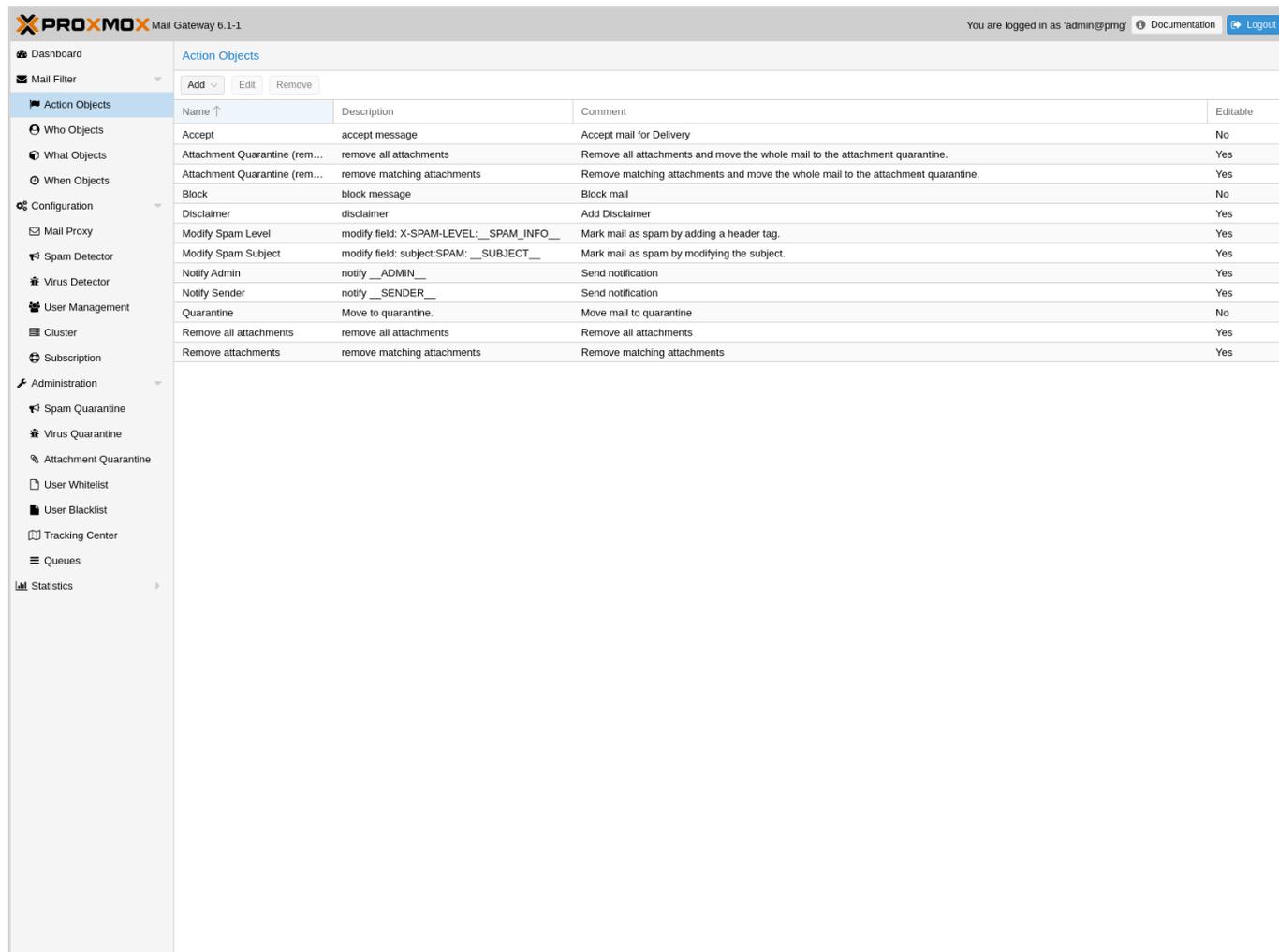
Rule applies for all outgoing e-mails

In & Out

Rule applies for both directions

And you can also disable a rule completely, which is mostly useful for testing and debugging. The *Factory Defaults* button allows you to reset the filter rules.

5.1 Action - objects



Name ↑	Description	Comment	Editable
Accept	accept message	Accept mail for Delivery	No
Attachment Quarantine (rem...	remove all attachments	Remove all attachments and move the whole mail to the attachment quarantine.	Yes
Attachment Quarantine (rem...	remove matching attachments	Remove matching attachments and move the whole mail to the attachment quarantine.	Yes
Block	block message	Block mail	No
Disclaimer	disclaimer	Add Disclaimer	Yes
Modify Spam Level	modify field: X-SPAM-LEVEL: __SPAM_INFO__	Mark mail as spam by adding a header tag.	Yes
Modify Spam Subject	modify field: subject:SPAM: __SUBJECT__	Mark mail as spam by modifying the subject.	Yes
Notify Admin	notify __ADMIN__	Send notification	Yes
Notify Sender	notify __SENDER__	Send notification	Yes
Quarantine	Move to quarantine.	Move mail to quarantine	No
Remove all attachments	remove all attachments	Remove all attachments	Yes
Remove attachments	remove matching attachments	Remove matching attachments	Yes

Please note that some actions stops further rule precessing. We call such actions *final*.

5.1.1 Accept

Accept mail for Delivery. This is a *final* action.

5.1.2 Block

Block mail. This is a *final* action.

5.1.3 Quarantine

Move to quarantine (virus mails are moved to the “virus quarantine”, other mails are moved to “spam quarantine”). This is also a *final* action.

5.1.4 Notification

Send notifications. Please note that object configuration can use [macros](#) Appendix D, so it is easy to include additional information. For example, the default *Notify Admin* object sends the following information:

Sample notification action body:

```
Proxmox Notification:
Sender:    __SENDER__
Receiver:  __RECEIVERS__
Targets:   __TARGETS__
Subject:   __SUBJECT__
Matching Rule: __RULE__

__RULE_INFO__

__VIRUS_INFO__
__SPAM_INFO__
```

Notification can also include a copy of the original mail.

5.1.5 Blind Carbon Copy (BCC)

The BCC object simply sends a copy to another target. It is possible to send the original unmodified mail, or the processed result. Please note that this can be quite different, i.e. when a previous rule removed attachments.

5.1.6 Header Attributes

This object is able to add or modify mail header attributes. As notice above, you can use [macros](#) Appendix D, making this a very powerful object. For example, the *Modify Spam Level* actions adds detailed information about detected Spam characteristics to the `X-SPAM-LEVEL` header.

Modify Spam Level Header Attribute

```
Field: X-SPAM-LEVEL
Value: __SPAM_INFO__
```

Another prominent example is the *Modify Spam Subject* action. This simply adds the *SPAM:* prefix to the original mail subject:

Modify Spam Subject Header Attribute

```
Field: subject
Value: SPAM: __SUBJECT__
```

5.1.7 Remove attachments

Remove attachments can either remove all attachments, or only those matched by the rules *What* - object. You can also specify the replacement text if you want.

You can optionally move those mails into the attachment quarantine, where the original mail with all attachments will be stored. The mail with the attachments removed will continue in the rule system.

Note

The Attachment Quarantine Lifetime is the same as for the Spam Quarantine.

5.1.8 Disclaimer

Add a Disclaimer.

5.2 Who - objects

The screenshot displays the Proxmox Mail Gateway 6.1-1 web interface. The top navigation bar includes the Proxmox logo, the version number, and the user's login information ('admin@pmg'). The left sidebar contains a menu with categories like 'Mail Filter', 'Who Objects', 'What Objects', 'When Objects', 'Configuration', and 'Administration'. The 'Who Objects' section is active, showing a table with columns 'Name' and 'Value'. A dropdown menu is open over the 'Add' button, listing options: Regular Expression, E-Mail, Domain, IP Address, IP Network, LDAP Group, and LDAP User. The 'Value' column contains the example 'nomail@fromthisdomain.com'.

This type of objects can be used for the *TO* and/or *FROM* category, and match the sender or receiver of the e-mail. A single object can combine multiple items, and the following item types are available:

EMail

Allows you to match a single mail address.

Domain

Only match the domain part of the mail address.

Regular Expression

This one uses a regular expression to match the whole mail address.

IP Address or Network

This can be used to match the senders IP address.

LDAP User or Group

Test if the mail address belong to a specific LDAP user or group.

We have two important *Who* - objects called *Blacklist* and *Whitelist*. Those are used in the default ruleset to globally block or allow specific senders.

5.3 What - objects

The screenshot shows the Proxmox Mail Gateway 6.1-1 administration interface. The left sidebar contains a navigation menu with categories like Dashboard, Mail Filter, Action Objects, Who Objects, What Objects, When Objects, Configuration, Mail Proxy, Spam Detector, Virus Detector, User Management, Cluster, Subscription, Administration, Spam Quarantine, Virus Quarantine, Attachment Quarantine, User Whitelist, User Blacklist, Tracking Center, Queues, and Statistics. The main content area is titled 'What Objects' and features a table of objects. A dropdown menu is open over the table, showing options: Spam Filter, Virus Filter, Match Field, Content Type Filter, Match Filename, Archive Filter, Content Type Filter, Content Type Filter, Content Type Filter, Content Type Filter, Match Filename, and Match Filename. The table lists various filters with their names and values.

Name	Value
Content Type Filter	content-type=application/javascript
Content Type Filter	content-type=application/x-executable
Content Type Filter	content-type=application/x-java
Content Type Filter	content-type=application/x-ms-dos-executable
Content Type Filter	content-type=application/x-ms-dos-executable
Content Type Filter	content-type=message/partial
Match Filename	filename=.*(vbs pif lnk shs shbt)
Match Filename	filename=.*\.{+}

What - objects are used to classify the mail content. A single object can combine multiple items, and the following item types are available:

Spam Filter

Matches if configured value is greater than the detected spam level.

Virus Filter

Matches on infected mails.

Match Field

Match specified mail header fields (eg. `Subject:`, `From:`, ...)

Content Type Filter

Can be used to match specific content types.

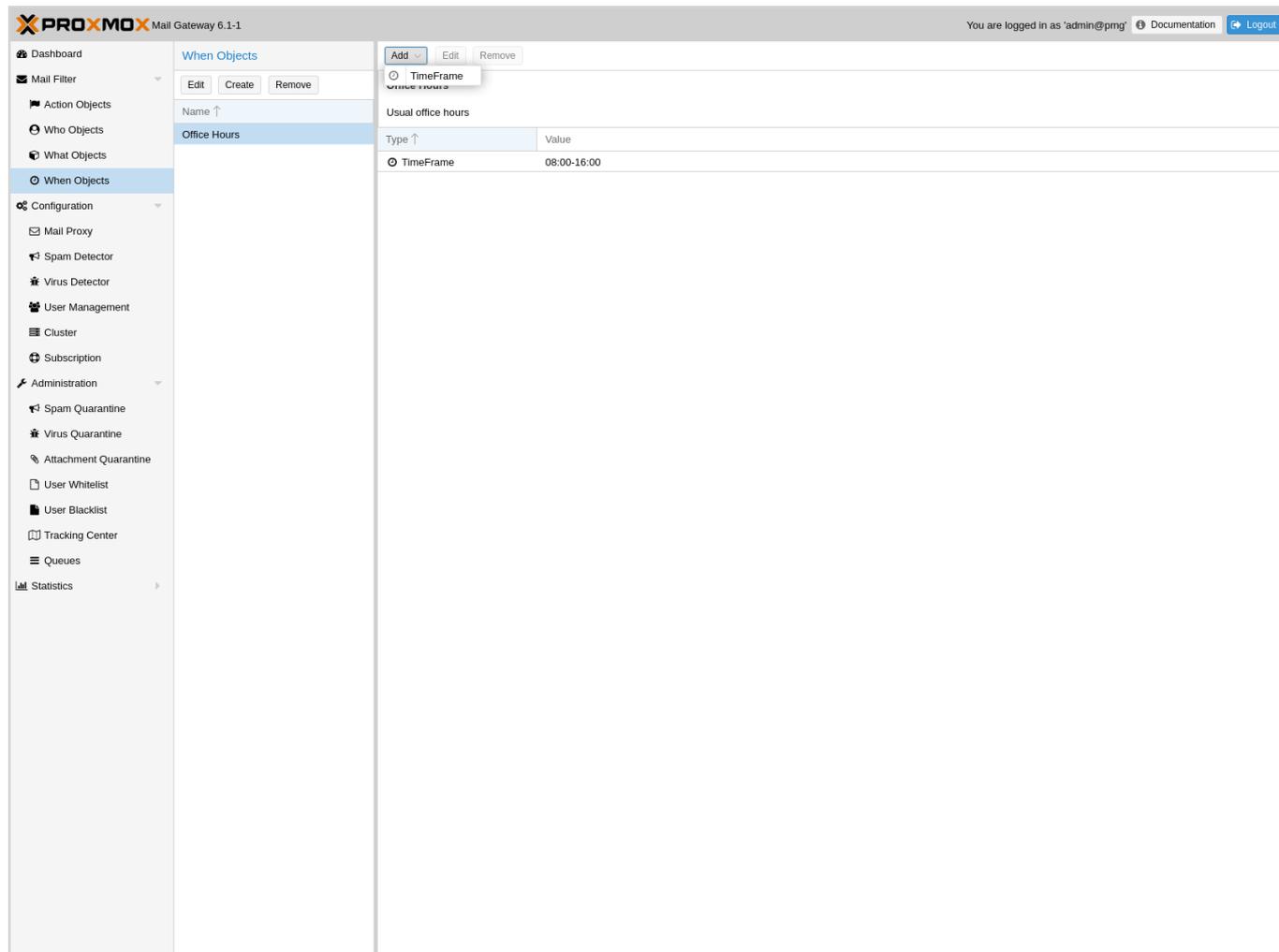
Match Filename

Uses regular expressions to match attachment filenames.

Archive Filter

Can be used to match specific content types inside archives.

5.4 When - objects



The screenshot shows the Proxmox Mail Gateway 6.1-1 administration interface. The left sidebar contains a navigation menu with categories like 'Mail Filter', 'Configuration', and 'Administration'. The main content area is titled 'When Objects' and features a table of objects. The 'Office Hours' object is selected, and its details are shown in a table below. The table has columns for 'Name', 'Type', and 'Value'. The 'Office Hours' object is of type 'TimeFrame' with a value of '08:00-16:00'.

Name	Type	Value
Office Hours	TimeFrame	08:00-16:00

When - objects are used to activate rules at specific daytimes. You can compose them of one or more time-frame items.

The default ruleset defines *Office Hours*, but this is not used by the default rules.

5.5 Using regular expressions

A regular expression is a string of characters which tells us which string you are looking for. The following is a short introduction in the syntax of regular expressions used by some objects. If you are familiar with Perl, you already know the syntax.

5.5.1 Simple regular expressions

In its simplest form, a regular expression is just a word or phrase to search for. `Mail` would match the string "Mail". The search is case sensitive so "MAIL", "Mail", "mail" would not be matched.

5.5.2 Metacharacters

Some characters have a special meaning. These characters are called metacharacters. The Period (.) is a commonly used metacharacter. It matches exactly one character, regardless of what the character is. `e.mail` would match either "e-mail" or "e-mail" or "e2mail" but not "e-some-mail".

The question mark (?) indicates that the character immediately preceding it either zero or one time. `e?mail` would match either "email" or "mail" but not "e-mail".

Another metacharacter is the star (*). This indicates that the character immediately to its left may repeated any number of times, including zero. `e*mail` would match either "email" or "mail" or "eeemail".

The plus (+) metacharacter does the same as the star (*) excluding zero. So `e+mail` does not match "mail".

Metacharacters may be combined. A common combination includes the period and star metacharacters (.*), with the star immediately following the period. This is used to match an arbitrary string of any length, including the null string. For example: `.*company.*` matches "company@domain.com" or "company@domain.co.uk" or "department.company@domain.com".

The book [\[Friedl97\]](#) provides a more comprehensive introduction.

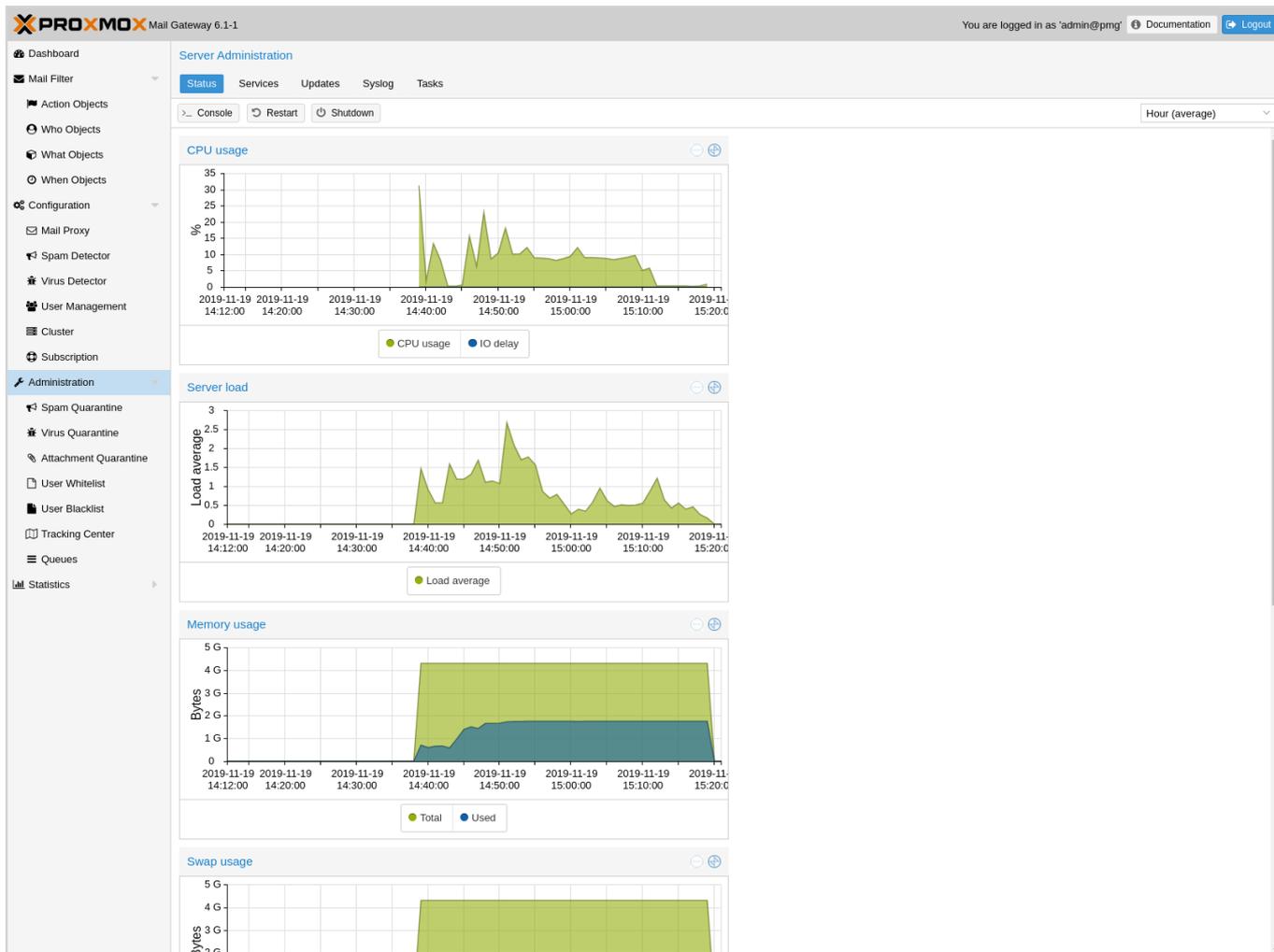
Chapter 6

Administration

The Administration GUI allows you to do common administration tasks like updating software packages, manage quarantine, view service status and manage mail queues. It also provides server statistics in order to verify server health.

6.1 Server Administration

6.1.1 Server status



This page shows server statistics about CPU, memory, disk and network usage. You can select the displayed time span on the upper right.

Administrators can open a terminal window using the *Console* button. It is also possible to trigger a server *Restart* or *Shutdown*.

6.1.2 Services

The screenshot shows the Proxmox Mail Gateway Administration interface. The top bar indicates the user is logged in as 'admin@pmg'. The left sidebar contains navigation menus for Dashboard, Mail Filter, Action Objects, Who Objects, What Objects, When Objects, Configuration, Mail Proxy, Spam Detector, Virus Detector, User Management, Cluster, Subscription, Administration, Spam Quarantine, Virus Quarantine, Attachment Quarantine, User Whitelist, User Blacklist, Tracking Center, Queues, and Statistics. The main content area is titled 'Server Administration' and has tabs for Status, Services (selected), Updates, Syslog, and Tasks. Below the tabs are buttons for Start, Stop, Restart, and Syslog. A table lists the following services:

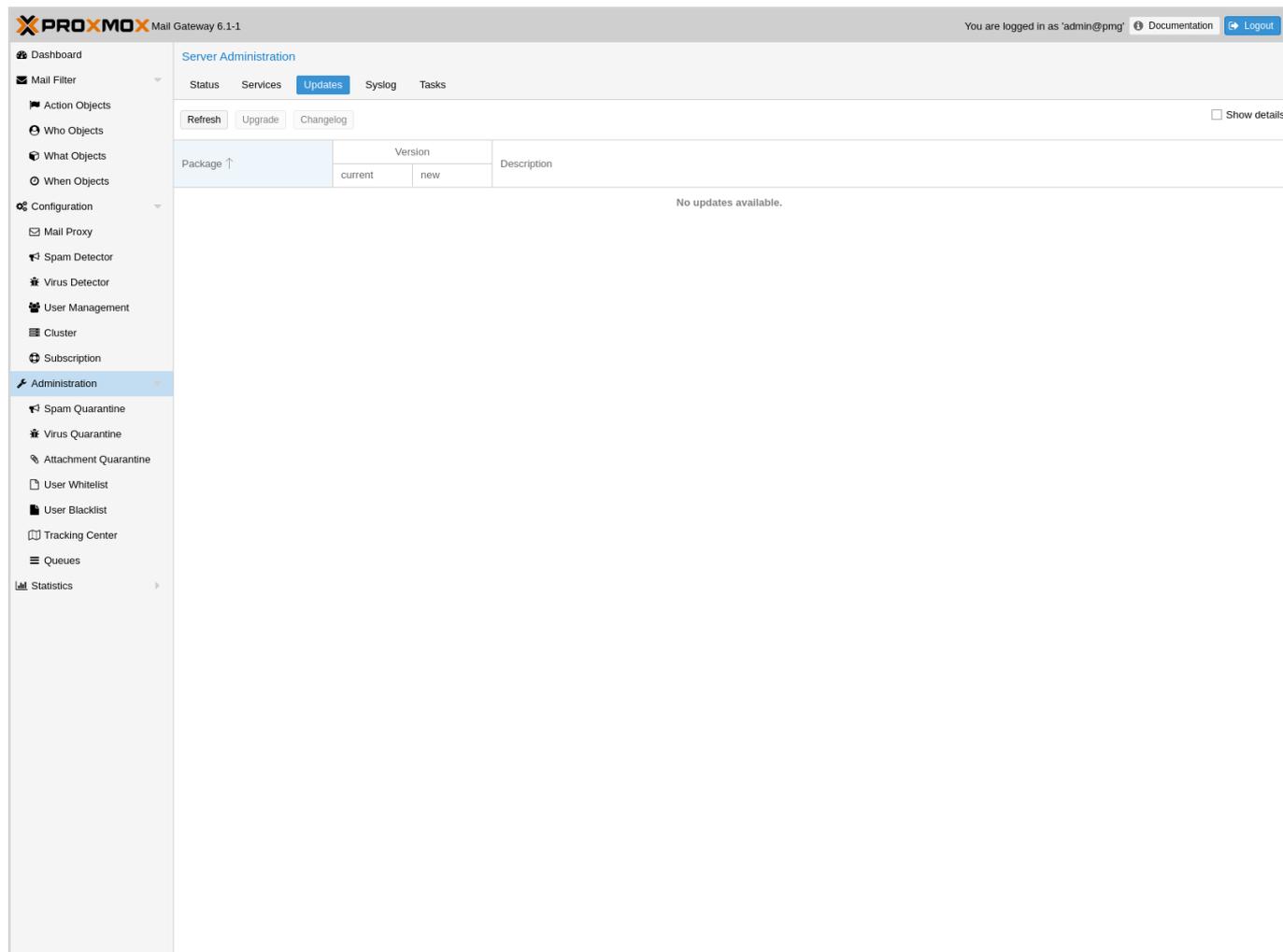
Name ↑	Status	Description
clamav-daemon	running	Clam AntiVirus userspace daemon
clamav-freshclam	running	ClamAV virus database updater
fetchmail	exited	LSB: init-Script for system wide fetchmail daemon
pmg-daily	success	Daily Proxmox Mail Gateway activities
pmg-hourly	success	Hourly Proxmox Mail Gateway activities
pmg-smtp-filter	running	Proxmox SMTP Filter Daemon
pmgdaemon	running	Proxmox Mail Gateway API Daemon
pmgmirror	dead	Proxmox Mail Gateway Database Mirror Daemon
pmgpolicy	running	Proxmox Mail Gateway Policy Daemon
pmgproxy	running	Proxmox Mail Gateway API
pmgreport	success	Send Daily System Report Mail
pmgspamreport	success	Send Daily Spam Report Mails
pmgtunnel	dead	Proxmox Mail Gateway Cluster Tunnel Daemon
postfix	running	Postfix Mail Transport Agent (instance -)
postgres	running	PostgreSQL Cluster 11-main
rsyslog	running	System Logging Service
ssh	running	OpenBSD Secure Shell server
systemd-timesyncd	dead	Network Time Synchronization

This panel lists all major services used for mail processing and cluster synchronization. If necessary, you can start, stop or restart them. The *Syslog* button shows the system log filtered for the selected service.

Please note that Proxmox Mail Gateway uses **systemd** to manage services, so you can also use the standard `systemctl` command line tool to manage or view service status, for example:

```
systemctl status postfix
```

6.1.3 Updates



The screenshot displays the Proxmox Mail Gateway Administration interface. The top navigation bar includes the Proxmox logo, the text 'Mail Gateway 6.1-1', and the user information 'You are logged in as 'admin@pmg'' with links for 'Documentation' and 'Logout'. The left sidebar contains a menu with categories: Dashboard, Mail Filter, Action Objects, Who Objects, What Objects, When Objects, Configuration, Administration, Spam Quarantine, Virus Quarantine, Attachment Quarantine, User Whitelist, User Blacklist, Tracking Center, Queues, and Statistics. The main content area is titled 'Server Administration' and has tabs for 'Status', 'Services', 'Updates', 'Syslog', and 'Tasks'. The 'Updates' tab is active, showing buttons for 'Refresh', 'Upgrade', and 'Changelog', and a 'Show details' checkbox. Below these is a table with columns for 'Package', 'Version', and 'Description'. The 'Version' column is further divided into 'current' and 'new'. The table is currently empty, displaying the message 'No updates available.'

We release software updates on a regular basis, and it is recommended to always run the latest available version. This page shows the available updates, and administrator can run an upgrade by pressing the *Upgrade* button.

See section [Package Repositories](#) Section 3.5 for details about available package repositories.

6.1.4 Syslog and Tasks

The screenshot shows the Proxmox Mail Gateway Administration interface. The top navigation bar includes the Proxmox logo, the version 'Mail Gateway 6.1-1', and the user 'admin@pmg'. The left sidebar contains a navigation menu with categories like Dashboard, Mail Filter, Configuration, Administration, and Statistics. The main content area is titled 'Server Administration' and has tabs for Status, Services, Updates, Syslog, and Tasks. The 'Syslog' tab is selected, displaying a list of log entries. At the top of the log view, there are controls for 'Live Mode', 'Select Timespan', 'Since' (2019-11-16), 'Until' (2019-11-20), and an 'Update' button. The log entries themselves are a list of timestamped messages from various system processes, such as 'pmg-freshclam[451]', 'pmg-clamd[453]', 'pmg-systemd[1]', 'pmg-policy[460]', 'pmg-smtp-filter[471]', 'pmg-proxy[483]', and 'pmg-daemon[476]'. The messages describe system updates, daemon startups, configuration changes, and service status reports.

The syslog page gives you a quick real-time log view. Please use the [Tracking Center](#) Section 6.3 to search the logs.

6.2 Quarantine

6.2.1 Spam

This panel lets you inspect the mail quarantine. Emails can be safely previewed and if desired, delivered to the original user.

The email preview on the web interface is very secure as malicious code (attacking your operating system or email client) is removed by Proxmox.

6.2.2 Virus

Allows administrators to inspect quarantined virus mails.

6.2.3 Attachment

Allows administrators to inspect quarantined mails and download their attachments or deliver/delete them.

Note

Use the options of the *Remove attachment* action to control the Attachment Quarantine.

6.2.4 User White- and Blacklist

This is mostly useful to debug or verify white- and blacklist user settings. The administrator should not change these values because users can manage this themselves.

6.3 Tracking Center

The screenshot displays the Proxmox Mail Gateway 6.1-1 Tracking Center. The interface includes a search filter with the following fields:

- Sender: [Text Input]
- Receiver: [Text Input]
- Filter: [Text Input]
- Start: 2019-11-19 14:56
- End: 2019-11-20 00:00
- Include Empty Senders:
- Include Greylist:

Below the filter is a search button and a table of tracking results:

Time	From	To	Status
Nov 19 15:22:02	noreply1574173321@nowhere.tld	user0@pmg-demo.tld	quarantine
Nov 19 15:22:03	noreply1574173322@nowhere.tld	user1@pmg-demo.tld	quarantine
Nov 19 15:22:04	noreply1574173323@nowhere.tld	user2@pmg-demo.tld	quarantine
Nov 19 15:22:05	noreply1574173324@nowhere.tld	user3@pmg-demo.tld	quarantine
Nov 19 15:56:07	noreply1574175367@nowhere.tld	test@test.tld	rejected
Nov 19 15:56:08	noreply1574175368@nowhere.tld	test@test.tld	rejected
Nov 19 15:56:09	noreply1574175369@nowhere.tld	test@test.tld	rejected
Nov 19 15:56:10	noreply1574175370@nowhere.tld	test@test.tld	rejected

Email processing is a complex task and involves several service daemons. Each daemon logs information to the syslog service. The problem is that a servers analyzes many emails in parallel, so it is usually very hard to find all logs corresponding to a specific mail.

Introduced in Proxmox Mail Gateway 2.1, the tracking center simplifies the search for emails dramatically. We use highly optimized C-code to search the available syslog data. This is very fast and powerful, and works for sites processing several million emails per day.

The result is a list of received mails, including the following data:

Time	Timestamp of first found syslog entry.
From	Envelope <i>From</i> address (the sender).
To	The email receiver address.
Status	Delivery status.
Syslog	The corresponding syslog entries are shown if you double click such entry, or if you press the + button on the left.

Please notice that you can specify filters, most important you can set a *Start* and *End* time. By default the start time is set to one hour ago. If you still get to much result entries, you can try to restrict the search to specific sender or receiver addresses, or search for a specific text in the logs (*Filter* entry).

Note

Search is faster if you use a short time interval.

The *Status* field summarize what happens with an email. Proxmox Mail Gateway is a mail proxy, meaning that the proxy receives mails from outside, process it and finally sends the result to the receiver.

The first phase is receiving the mail. The proxy may reject the mail early, or instead accepts the mail and feeds it into the filter. The filter rules can block or accept the mail.

In the second phase, accepted mails need to be delivered to the receiver, and this action may also fail or succeed. The status combines the result from the first and second phase:

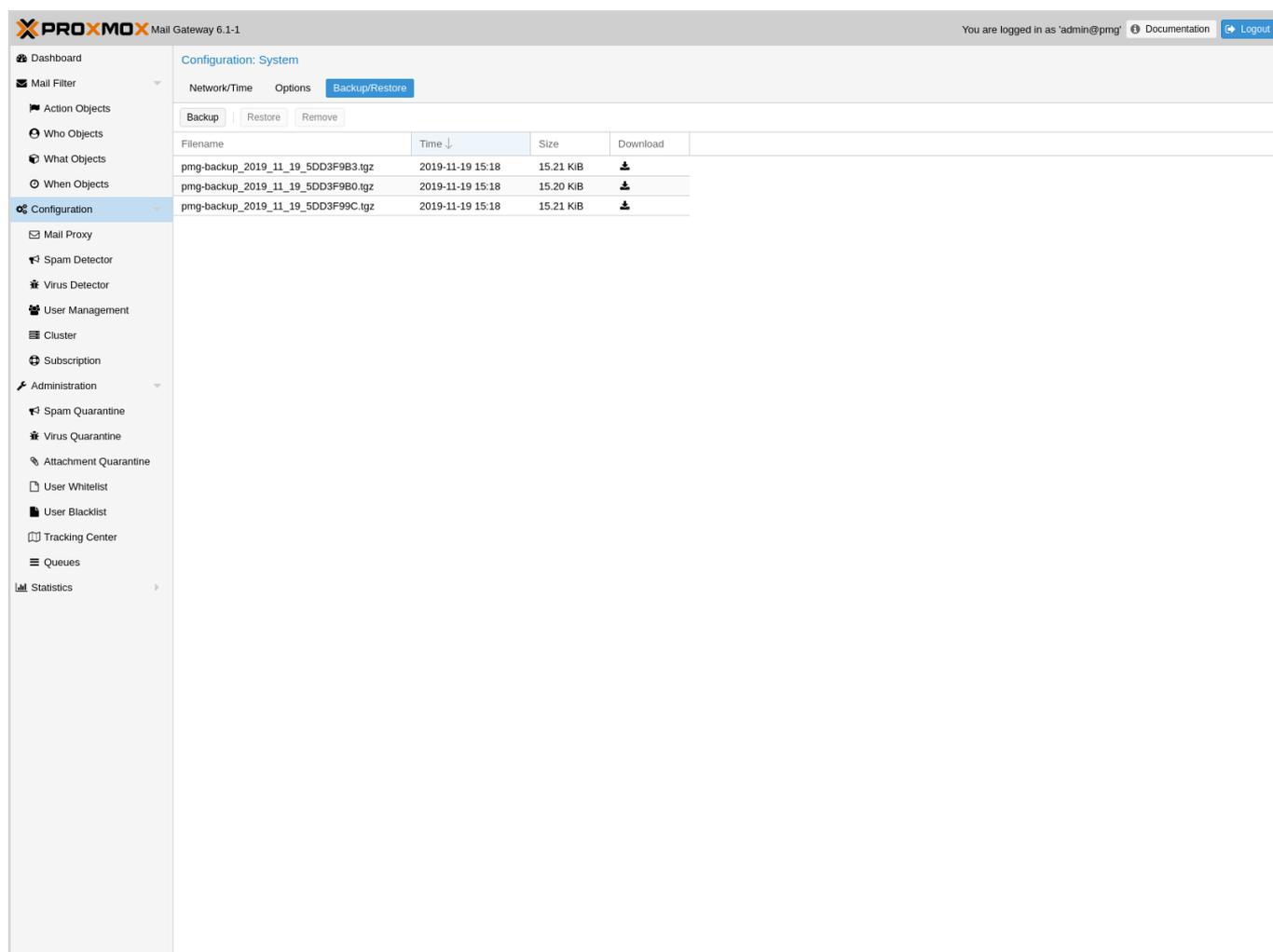
Status	Phase	Description
rejected	1	Email rejected (e.g. sender IP is listed on a IP blacklist)
greylisted	1	Email temporarily rejected by greylisting
queued/deferred	1	Internal Email was queued, still trying to deliver
queued/bounced	1	Internal Email was queued but not accepted by the target email server (e. g. user unknown)
quarantine	1	Email was moved to quarantine
blocked	1	Email was blocked by filter rules
accepted/deferred	2	Email accepted, still trying to deliver
accepted/bounced	2	Email accepted but not accepted by the target email server (e. g. user unknown)
accepted/delivered	2	Email accepted and delivered

6.4 Postfix Queue Administration

TODO

Chapter 7

Backup and Restore



The screenshot displays the Proxmox Mail Gateway administration interface. The top navigation bar shows the Proxmox logo, the version 'Mail Gateway 6.1-1', and the user 'admin@pmg'. The left sidebar contains a menu with categories like Mail Filter, Configuration, and Administration. The main content area is titled 'Configuration: System' and has tabs for 'Network/Time', 'Options', and 'Backup/Restore'. Under the 'Backup/Restore' tab, there are buttons for 'Backup', 'Restore', and 'Remove'. Below these buttons is a table listing backup files.

Filename	Time ↓	Size	Download
pmg-backup_2019_11_19_5DD3F9B3.tgz	2019-11-19 15:18	15.21 KiB	
pmg-backup_2019_11_19_5DD3F9B0.tgz	2019-11-19 15:18	15.20 KiB	
pmg-backup_2019_11_19_5DD3F99C.tgz	2019-11-19 15:18	15.21 KiB	

Proxmox Mail Gateway includes the ability to backup and restore the configuration. This includes the complete config from `/etc/pmg/`, the mail filter rules and the statistic database.

Note

The backup does not include the network setup, and also no mail data from the postfix queue or the spam or virus quarantine.

You can create a backup by simply pressing the *Backup* button on the GUI, or by using the command line interface:

```
# pmgbackup backup
starting backup to: /var/lib/pmg/backup/pmg-backup_2018_01_04_5A4E0436.tgz
backup finished
```

Backups are stored inside directory `/var/lib/pmg/backup/`. It is usually best to mount a remote file system to that directory, so that the resulting backups gets stored remotely.

You can list the contents of that directory with:

```
# pmgbackup list
....
pmg-backup_2017_11_10_5A05D4B9.tgz      17012
pmg-backup_2017_11_13_5A09676A.tgz    16831
pmg-backup_2018_01_04_5A4E0436.tgz    21514
```

Restores are also possible using the GUI or command line, and you can select what parts you want to restore:

System Configuration

Basically the contents of `/etc/pmg/`.

Rule Database

The mail filter rule database.

Statistic

All statistical data.

For example, you can selectively restore the mail filter rules from an older backup:

```
# pmgbackup restore --filename pmg-backup_2018_01_04_5A4E0436.tgz -- ↵
database
starting restore: /var/lib/pmg/backup/pmg-backup_2018_01_04_5A4E0436.tgz
config_backup.tar: OK
Proxmox_ruledb.sql: OK
Proxmox_statdb.sql: OK
version.txt: OK
Destroy existing rule database
Create new database
run analyze to speed up database queries
Analyzing/Upgrading existing Databases...done
restore finished
```

Chapter 8

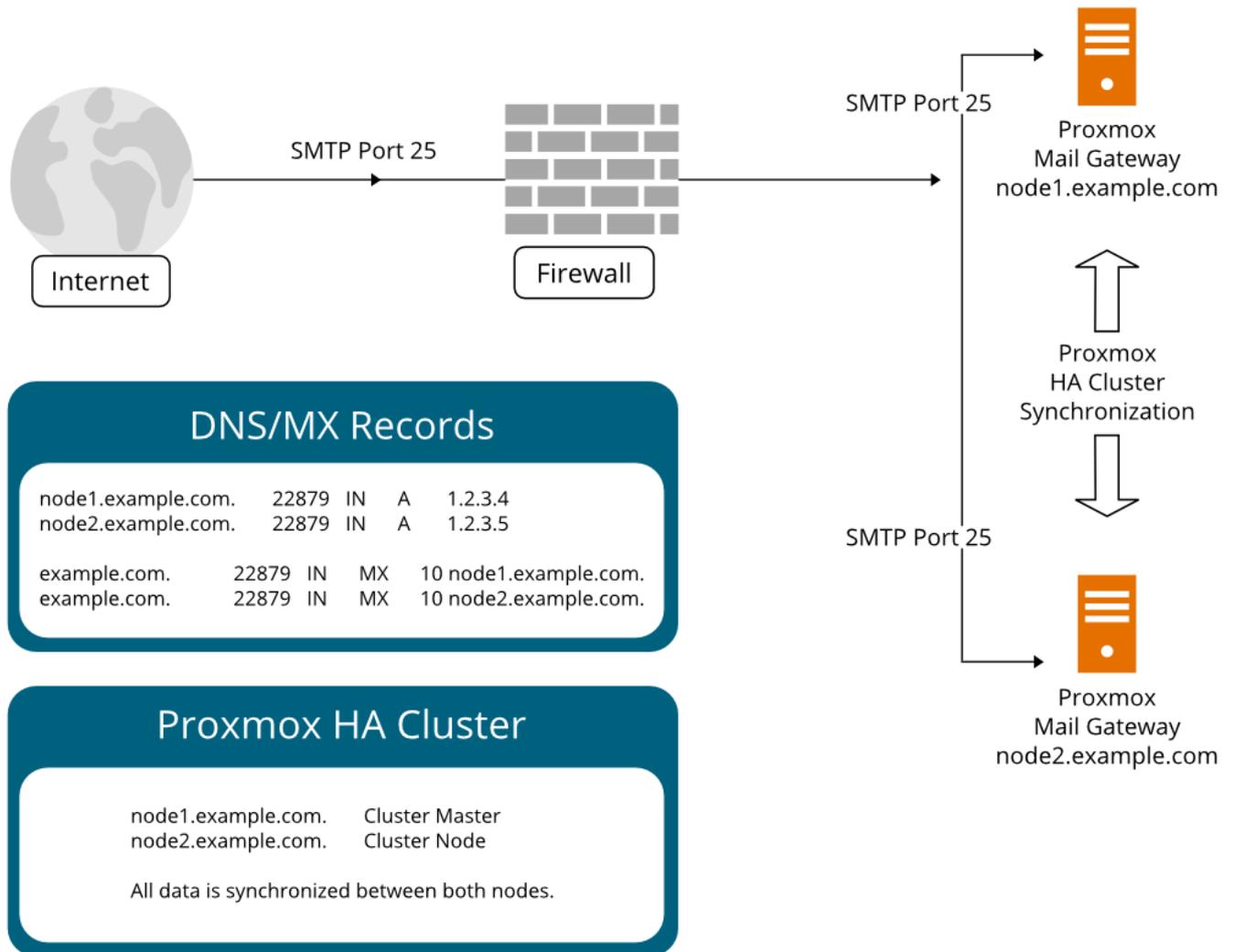
Cluster Management

We are living in a world where email becomes more and more important - failures in email systems are just not acceptable. To meet these requirements we developed the Proxmox HA (High Availability) Cluster.

The Proxmox Mail Gateway HA Cluster consists of a master and several slave nodes (minimum one node). Configuration is done on the master. Configuration and data is synchronized to all cluster nodes over a VPN tunnel. This provides the following advantages:

- centralized configuration management
- fully redundant data storage
- high availability
- high performance

We use a unique application level clustering scheme, which provides extremely good performance. Special considerations were taken to make management as easy as possible. Complete Cluster setup is done within minutes, and nodes automatically reintegrate after temporary failures without any operator interaction.



8.1 Hardware requirements

There are no special hardware requirements, although it is highly recommended to use fast and reliable server with redundant disks on all cluster nodes (Hardware RAID with BBU and write cache enabled).

The HA Cluster can also run in virtualized environments.

8.2 Subscriptions

Each host in a cluster has its own subscription. If you want support for a cluster, each cluster node needs to have a valid subscription. All nodes must have the same subscription level.

8.3 Load balancing

It is usually advisable to distribute mail traffic among all cluster nodes. Please note that this is not always required, because it is also reasonable to use only one node to handle SMTP traffic. The second node is used as quarantine host, and only provides the web interface to the user quarantine.

The normal mail delivery process looks up DNS Mail Exchange (MX) records to determine the destination host. A MX record tells the sending system where to deliver mail for a certain domain. It is also possible to have several MX records for a single domain, they can have different priorities. For example, our MX record looks like that:

```
# dig -t mx proxmox.com

;; ANSWER SECTION:
proxmox.com.          22879    IN      MX      10 mail.proxmox.com.

;; ADDITIONAL SECTION:
mail.proxmox.com.    22879    IN      A       213.129.239.114
```

Please notice that there is one single MX record for the Domain `proxmox.com`, pointing to `mail.proxmox.com`. The `dig` command automatically puts out the corresponding address record if it exists. In our case it points to `213.129.239.114`. The priority of our MX record is set to 10 (preferred default value).

8.3.1 Hot standby with backup MX records

Many people do not want to install two redundant mail proxies, instead they use the mail proxy of their ISP as fallback. This is simply done by adding an additional MX Record with a lower priority (higher number). With the example above this looks like that:

```
proxmox.com.          22879    IN      MX      100 mail.provider.tld.
```

In such a setup, your provider must accept mails for your domain and forward them to you. Please note that this is not advisable, because spam detection needs to be done by the backup MX server as well, and external servers provided by ISPs usually don't.

However, you will never lose mails with such a setup, because the sending Mail Transport Agent (MTA) will simply deliver the mail to the backup server (`mail.provider.tld`) if the primary server (`mail.proxmox.com`) is not available.

Note

Any reasonable mail server retries mail delivery if the target server is not available, i.e. Proxmox Mail Gateway stores mail and retries delivery for up to one week. So you will not lose mail if your mail server is down, even if you run a single server setup.

8.3.2 Load balancing with MX records

Using your ISPs mail server is not always a good idea, because many ISPs do not use advanced spam prevention techniques, or do not filter SPAM at all. It is often better to run a second server yourself to avoid lower spam detection rates.

Anyways, it's quite simple to set up a high performance load balanced mail cluster using MX records. You just need to define two MX records with the same priority. Here is a complete example to make it clearer.

First, you need to have at least 2 working Proxmox Mail Gateway servers (mail1.example.com and mail2.example.com) configured as cluster (see section [Cluster administration](#) Section 8.4 below), each having its own IP address. Let us assume the following addresses (DNS address records):

```
mail1.example.com.      22879   IN      A       1.2.3.4
mail2.example.com.      22879   IN      A       1.2.3.5
```

It is always a good idea to add reverse lookup entries (PTR records) for those hosts. Many email systems nowadays reject mails from hosts without valid PTR records. Then you need to define your MX records:

```
example.com.           22879   IN      MX      10 mail1.example.com.
example.com.           22879   IN      MX      10 mail2.example.com.
```

This is all you need. You will receive mails on both hosts, more or less load-balanced using round-robin scheduling. If one host fails the other one is used.

8.3.3 Other ways

Multiple address records

Using several DNS MX records is sometimes clumsy if you have many domains. It is also possible to use one MX record per domain, but multiple address records:

```
example.com.           22879   IN      MX      10 mail.example.com.
mail.example.com.      22879   IN      A       1.2.3.4
mail.example.com.      22879   IN      A       1.2.3.5
```

Using firewall features

Many firewalls can do some kind of RR-Scheduling (round-robin) when using DNAT. See your firewall manual for more details.

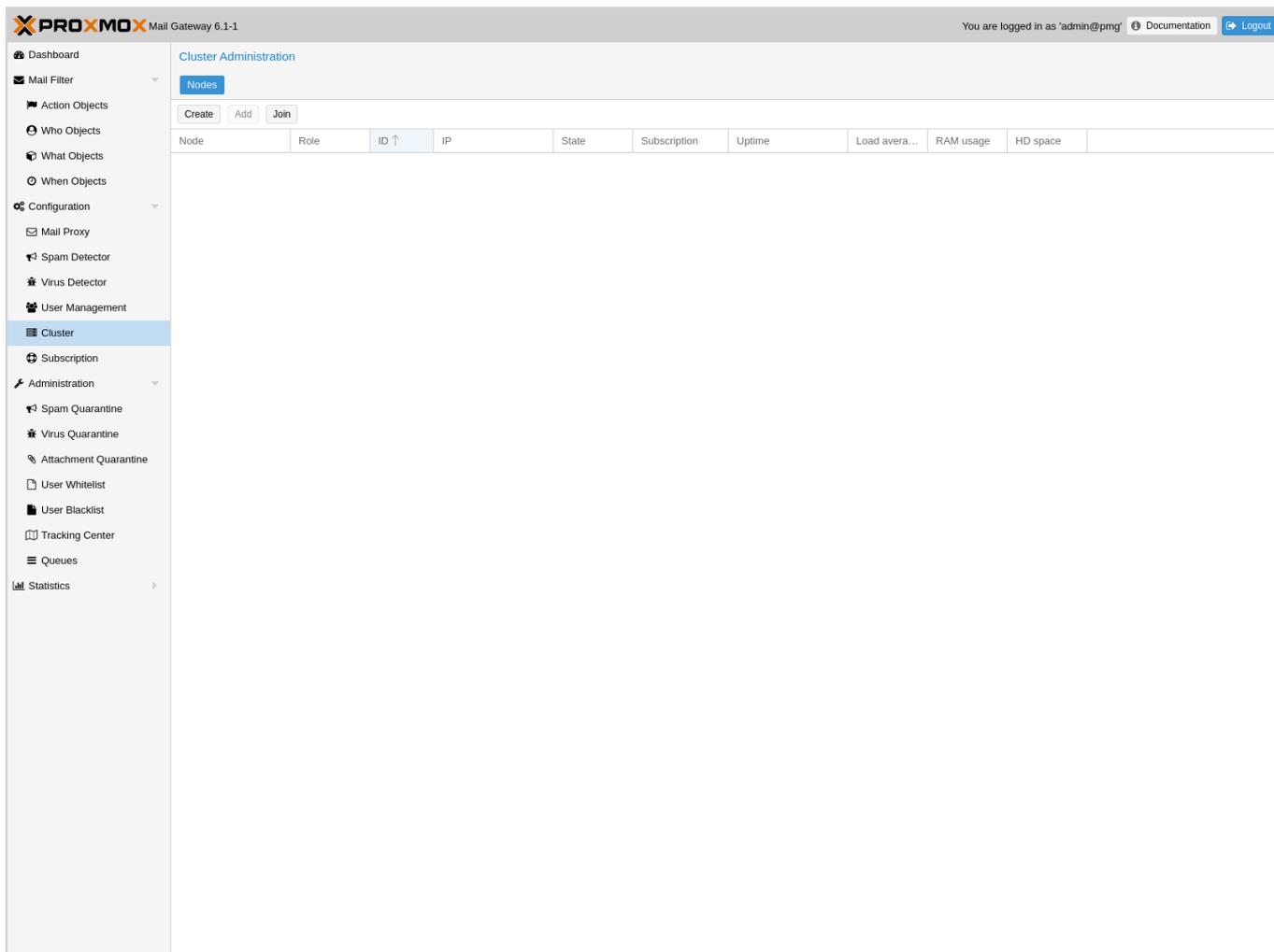
8.4 Cluster administration

Cluster administration can be done on the GUI or using the command line utility `pmgcm`. The CLI tool is a bit more verbose, so we suggest to use that if you run into problems.

Note

Always setup the IP configuration before adding a node to the cluster. IP address, network mask, gateway address and hostname can't be changed later.

8.4.1 Creating a Cluster



You can create a cluster from any existing Proxmox Mail Gateway host. All data is preserved.

- make sure you have the right IP configuration (IP/MASK/GATEWAY/HOSTNAME), because you cannot change that later
- press the create button on the GUI, or run the cluster creation command:

```
pmgcm create
```

Note

The node where you run the cluster create command will be the *master* node.

8.4.2 Show Cluster Status

The GUI shows the status of all cluster nodes, and it is also possible to use the command line tool:

```

pmgcm status
--NAME (CID)-----IPADDRESS---ROLE-STATE-----UPTIME---LOAD----- ↔
  MEM---DISK
pmg5 (1)                192.168.2.127   master A         1 day 21:18    0.30          ↔
  80%                   41%

```

8.4.3 Adding Cluster Nodes

The screenshot shows the Proxmox Mail Gateway 6.1-1 GUI. The left sidebar contains a navigation menu with categories like Mail Filter, Configuration, Administration, and Statistics. The main content area is titled 'Cluster Administration' and has a 'Nodes' tab selected. Below the tab are 'Create', 'Add', and 'Join' buttons. A table with columns for Node, Role, ID, IP, State, Subscription, Uptime, Load average, RAM usage, and HD space is visible. A 'Cluster Join' dialog box is open in the center, with fields for IP Address, Password, and Fingerprint, and buttons for Help, OK, and Reset.

When you add a new node to a cluster (using `join`) all data on that node is destroyed. The whole database is initialized with cluster data from the master.

- make sure you have the right IP configuration
- run the cluster join command (on the new node):

```
pmgcm join <master_ip>
```

You need to enter the root password of the master host when asked for a password. When joining a cluster using the GUI, you also need to enter the *fingerprint* of the master node. You get that information by pressing the `Add` button on the master node.

**Caution**

Node initialization deletes all existing databases, stops and then restarts all services accessing the database. So do not add nodes which are already active and receive mails.

Also, joining a cluster can take several minutes, because the new node needs to synchronize all data from the master (although this is done in the background).

Note

If you join a new node, existing quarantined items from the other nodes are not synchronized to the new node.

8.4.4 Deleting Nodes

Please detach nodes from the cluster network before removing them from the cluster configuration. Then run the following command on the master node:

```
pmgcm delete <cid>
```

Parameter <cid> is the unique cluster node ID, as listed with `pmgcm status`.

8.4.5 Disaster Recovery

It is highly recommended to use redundant disks on all cluster nodes (RAID). So in almost any circumstances you just need to replace the damaged hardware or disk. Proxmox Mail Gateway uses an asynchronous clustering algorithm, so you just need to reboot the repaired node, and everything will work again transparently.

The following scenarios only apply when you really lose the contents of the hard disk.

Single Node Failure

- delete failed node on master

```
pmgcm delete <cid>
```

- add (re-join) a new node

```
pmgcm join <master_ip>
```

Master Failure

- force another node to be master

```
pmgcm promote
```

- tell other nodes that master has changed

```
pmgcm sync --master_ip <master_ip>
```

Total Cluster Failure

- restore backup (Cluster and node information is not restored, you have to recreate master and nodes)
- tell it to become master

```
pmgcm create
```

- install new nodes
- add those new nodes to the cluster

```
pmgcm join <master_ip>
```

Chapter 9

Important Service Daemons

9.1 pmgdaemon - Proxmox Mail Gateway API Daemon

This daemon exposes the whole Proxmox Mail Gateway API on `127.0.0.1:85`. It runs as `root` and has permission to do all privileged operations.

Note

The daemon listens to a local address only, so you cannot access it from outside. The `pmgproxy` daemon exposes the API to the outside world.

9.2 pmgproxy - Proxmox Mail Gateway API Proxy Daemon

This daemon exposes the whole Proxmox Mail Gateway API on TCP port 8006 using HTTPS. It runs as user `www-data` and has very limited permissions. Operations requiring more permissions are forwarded to the local `pmgdaemon`.

Requests targeted for other nodes are automatically forwarded to those nodes. This means that you can manage your whole cluster by connecting to a single Proxmox Mail Gateway node.

9.2.1 Alternative HTTPS certificate

By default, `pmgproxy` uses the certificate `/etc/pmg/pmg-api.pem` for HTTPS connections. This certificate is self signed, and therefore not trusted by browsers and operating systems by default. You can simply replace this certificate with your own (please include the key inside the `.pem` file).

9.2.2 Host based Access Control

It is possible to configure “apache2”-like access control lists. Values are read from file `/etc/default/pmgproxy`. For example:

```
ALLOW_FROM="10.0.0.1-10.0.0.5,192.168.0.0/22"
DENY_FROM="all"
POLICY="allow"
```

IP addresses can be specified using any syntax understood by `Net::IP`. The name `all` is an alias for `0/0`.

The default policy is `allow`.

Match	POLICY=deny	POLICY=allow
Match Allow only	allow	allow
Match Deny only	deny	deny
No match	deny	allow
Match Both Allow & Deny	deny	allow

9.2.3 SSL Cipher Suite

You can define the cipher list in `/etc/default/pmgproxy`, for example

```
CIPHERS="ECDHE-ECDSA-AES256-GCM-SHA384:ECDHE-RSA-AES256-GCM-SHA384:↔
ECDHE-ECDSA-CHACHA20-POLY1305:ECDHE-RSA-CHACHA20-POLY1305:↔
ECDHE-ECDSA-AES128-GCM-SHA256:ECDHE-RSA-AES128-GCM-SHA256:↔
AES256-SHA384:ECDHE-RSA-AES256-SHA384:ECDHE-ECDSA-AES128-SHA256:↔
ECDHE-RSA-AES128-SHA256"
```

Above is the default. See the `ciphers(1)` man page from the `openssl` package for a list of all available options.

Additionally you can define that the client chooses the used cipher in `/etc/default/pmgproxy` (default is the first cipher in the list available to both client and `pmgproxy`):

```
HONOR_CIPHER_ORDER=0
```

9.2.4 Diffie-Hellman Parameters

You can define the used Diffie-Hellman parameters in `/etc/default/pmgproxy` by setting `DHPARAMS` to the path of a file containing DH parameters in PEM format, for example

```
DHPARAMS="/path/to/dhparams.pem"
```

If this option is not set, the built-in `skip2048` parameters will be used.

Note

DH parameters are only used if a cipher suite utilizing the DH key exchange algorithm is negotiated.

9.2.5 COMPRESSION

By default `pmgproxy` uses gzip HTTP-level compression for compressible content, if the client supports it. This can be disabled in `/etc/default/pmgproxy`

```
COMPRESSION=0
```

9.3 pmg-smtp-filter - Proxmox SMTP Filter Daemon

This is the Proxmox SMTP filter daemon, which does the actual SPAM filtering using the SpamAssassin and the rule database. It listens on `127.0.0.1:10023` and `127.0.0.1:10024`. The daemon listens to a local address only, so you cannot access it from outside.

With our postfix configuration, incoming mails are sent to `127.0.0.1:10024`. Outgoing (trusted) mails are sent to `127.0.0.1:10023`. After filtering, mails are reinjected into postfix at `127.0.0.1:10025`.

9.4 pmgpolicy - Proxmox Mail Gateway Policy Daemon

This daemon implements the Postfix SMTP access policy delegation protocol on `127.0.0.1:10022`. The daemon listens to a local address only, so you cannot access it from outside. We configure Postfix to use this service for greylisting and as SPF policy server.

9.5 pmgtunnel - Cluster Tunnel Daemon

This daemon creates a ssh tunnel to the postgres database in other cluster nodes (port 5432). The tunnel is used to synchronize the database using an application specific asynchronous replication algorithm.

9.6 pmgmirror - Database Mirror Daemon

Proxmox Mail Gateway uses an application specific asynchronous replication algorithm to replicate the database to all cluster nodes.

The daemon uses the ssh tunnel provided by `pmgtunnel` to access the database on remote nodes.

Chapter 10

Useful Command Line Tools

10.1 pmgdb - Database Management Toolkit

The `pmgdb` toolkit is used to simplify common database management tasks. Most important, it is used internally to create and initialize the default database. You can also use it to reset the filter rules back to factory defaults:

```
pmgdb reset
```

Or you can dump a human readable copy of the filter rules:

```
pmgdb dump
```

10.2 pmgsh - API Shell

The `pmgsh` tool can be used to access the Proxmox Mail Gateway API via the command line.

Examples

List entries:

```
# pmgsh ls /
```

Call method *GET* on an specific API path:

```
# pmgsh get /version
```

View current mail configuration:

```
# pmgsh get /config/mail
```

Get help for a specific path:

```
# pmgsh help /config/mail -v
```

Disable option *spf* in */config/mail*

```
# pmgsh set /config/mail -spf 0
```

Delete *spf* setting from */config/mail*

```
# pmgsh set /config/mail -delete spf
```

10.3 pmgversion - Version Info

The binary `pmgversion` prints detailed version information for Proxmox Mail Gateway packages.

Examples

Print Proxmox Mail Gateway version:

```
# pmgversion
```

List version details for important packages:

```
# pmgversion -v
```

Please use the Debian package management for details about other packages

```
# dpkg -l
```

10.4 pmgsubscription - Subscription Management

Proxmox Mail Gateway is free open software, and the company that developed it (Proxmox Server Solutions GmbH) offers **support** in many ways, with different support channel, level and pricing.

The tool `pmgsubscription` is used to handle Proxmox Mail Gateway subscriptions. Please use the GUI or the `set` command to upload a new key:

```
# pmgsubscription set <key>
```

Note

Subscription keys are bound to specific servers (*Server ID*), so you can use them for exactly one server. Each server needs its own key.

The `get` command is used to view the current subscription status:

```
# pmgsubscription get
key: pmgc-xxxxxxxxxxx
level: c
productname: Proxmox Mail Gateway Trial Subscription 1 year
regdate: 2017-12-15 00:00:00
serverid: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
status: Active
url: https://www.proxmox.com/en/proxmox-mail-gateway/pricing
```

10.5 pmgperf - Proxmox Simple Performance Benchmark

The command line tool `pmgperf` tries to gather some general performance data. This is mostly useful for debugging and to identify performance bottlenecks. It computes the following metrics:

CPU bogomips sum of all CPUs
BOGOMIPS

REGEX/SECOND regular expressions per second (perl performance test), should be above 1000000.

HD SIZE harddisk size

BUFFERED simple HD read test. Modern HDs should reach at least 100 MB/sec
READS

AVERAGE tests average seek time. Fast SCSI HDs reach values < 8 milliseconds. Common
SEEK TIME IDE/SATA disks get values from 15 to 20 ms. SSD seek times should be below 1ms.

FSYNCS/SECOND value should be greater than 200 (you should enable *write back* cache mode on you
RAID controller - needs a battery backed cache (BBWC)).

DNS EXT average time to resolve an external DNS name

DNS INT average time to resolve a local DNS name

Here is an example output generated by the tool:

```
# pmgperf
CPU BOGOMIPS:      16759.60
REGEX/SECOND:     1186304
HD SIZE:          60.78 GB (/dev/sda1)
BUFFERED READS:   209.84 MB/sec
AVERAGE SEEK TIME: 1.24 ms
FSYNCS/SECOND:    2198.79
DNS EXT:          35.69 ms
DNS INT:          1.41 ms (yourdomain.tld)
```

10.6 pmgqm - Quarantine Management Toolkit

Toolkit to manage spam and virus quarantine, and send spam report mails.

10.7 pmgreport - Send daily system report email

This binary generates and sends daily system report email.

10.8 pmgupgrade - Upgrade Proxmox Mail Gateway

This is a small wrapper around `apt-get dist-upgrade`. We use this to print additional information (kernel restart required?), and optionally run an interactive shell after the update. This binary is invoked when starting an upgrade using the web GUI.

If you are already logged in on the console, it is preferable to invoke `apt-get` directly.

```
# apt-get dist-upgrade
```

10.9 nmap - Port Scans

`nmap` is designed to allow system administrators to scan large networks to determine which hosts are up and what services they are offering. You can use `nmap` to test your firewall setting, for example to see if the required ports are open.

Test Razor port (tcp port 2703):

```
# nmap -P0 -sS -p 2703 c301.cloudmark.com

Starting Nmap 5.00 ( http://nmap.org ) at 2012-07-31 11:10 CEST
Interesting ports on c301.cloudmark.com (208.83.137.114):
PORT      STATE SERVICE
```

```
2703/tcp open  unknown
```

```
Nmap done: 1 IP address (1 host up) scanned in 0.17 seconds
```

See the manual page (`man nmap`) for more information about nmap.

Chapter 11

Frequently Asked Questions

Note

New FAQs are appended to the bottom of this section.

1. *What distribution is Proxmox Mail Gateway based on?*

Proxmox Mail Gateway is based on [Debian GNU/Linux](#)

2. *What license does the Proxmox Mail Gateway project use?*

Proxmox Mail Gateway code is licensed under the GNU Affero General Public License, version 3 (since the 5.0 release).

3. *Will Proxmox Mail Gateway run on a 32bit processor?*

Proxmox Mail Gateway works only on 64-bit CPUs (AMD or Intel). There is no plan for 32-bit for the platform.

4. *How long will my Proxmox Mail Gateway version be supported?*

Proxmox Mail Gateway versions are supported at least as long as the corresponding Debian Version is [oldstable](#). Proxmox Mail Gateway uses a rolling release model and using the latest stable version is always recommended.

Proxmox Mail Gateway Version	Debian Version	First Release	Debian EOL	Proxmox EOL
Proxmox Mail Gateway 6.x	Debian 10 (Buster)	2019-08	tba	tba
Proxmox Mail Gateway 5.x	Debian 9 (Stretch)	2018-01	2020-07	2020-07

Note

Proxmox Mail Gateway releases before 5.0 are not listed here. As they are all EOL (End Of Life) it's highly recommended to upgrade to a newer version if still in use.

How can I upgrade Proxmox Mail Gateway to the next release?

Minor version upgrades, for example upgrading from Proxmox Mail Gateway in version 5.1 to 5.2, can be done just like any normal update, either through the Webinterface's *Node* → *Updates* panel or through the CLI with:

```
apt update
apt full-upgrade
```

Note

Always ensure you correctly setup the [package repositories](#) Section 3.5 and only continue with the actual upgrade if `apt update` did not hit any error.

Major version upgrades, for example going from Proxmox Mail Gateway 5.4 to 6.0, are also supported. They must be carefully planned and tested and should **never** be started without having a current backup ready. Although the specific upgrade steps depend on your respective setup, we provide general instructions and advice of how a upgrade should be performed:

- [Upgrade from Proxmox Mail Gateway 5.x to 6.0](#)

Chapter 12

Bibliography

12.1 Books about mail processing technology

- [1] [KyleDDent04] Kyle D Dent. Postfix: The Definitive Guide. O'Reilly & Associates, 2004. ISBN 978-0596002121
- [2] [Schwartz04] Alan Schwartz. SpamAssassin. O'Reilly & Associates, 2004. ISBN 978-0596007072

12.2 Books about related technology

- [3] [Hertzog13] Raphaël Hertzog & Roland Mas. [The Debian Administrator's Handbook: Debian Jessie from Discovery to Mastery](#), Freexian, 2013. ISBN 979-1091414050
 - [4] [Bir96] Kenneth P. Birman. Building Secure and Reliable Network Applications. Manning Publications Co, 1996. ISBN 978-1884777295
 - [5] [Walsh10] Norman Walsh. DocBook 5: The Definitive Guide. O'Reilly & Associates, 2010. ISBN 978-0596805029
 - [6] [Richardson07] Leonard Richardson & Sam Ruby. RESTful Web Services. O'Reilly Media, 2007. ISBN 978-0596529260
 - [7] [Friedl97] Jeffrey E. F. Friedl. Mastering Regular Expressions. O'Reilly & Associates, 2006. ISBN 978-0596528126
 - [8] [Mauerer08] Wolfgang Mauerer. Professional Linux Kernel Architecture. John Wiley & Sons, 2008. ISBN 978-0470343432
 - [9] [Loshin03] Pete Loshin, IPv6: Theory, Protocol, and Practice, 2nd Edition. Morgan Kaufmann, 2003. ISBN 978-1558608108
 - [10] [Loeliger12] Jon Loeliger & Matthew McCullough. Version Control with Git: Powerful tools and techniques for collaborative software development. O'Reilly and Associates, 2012. ISBN 978-1449316389
 - [11] [Ahmed16] Wasim Ahmed. Mastering Proxmox - Second Edition. Packt Publishing, 2016. ISBN 978-1785888243
-

12.3 Books about related topics

- [12] [Bessen09] James Bessen & Michael J. Meurer, Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators at Risk. Princeton Univ Press, 2009. ISBN 978-0691143217

Appendix A

SSL certificate

Access to the administration web interface is always done via `https`. The default certificate is never valid for your browser and you get always warnings.

If you want to get rid of these warnings, you have to generate a valid certificate for your server.

Login to your Proxmox via `ssh` or use the console:

```
openssl req -newkey rsa:2048 -nodes -keyout key.pem -out req.pem
```

Follow the instructions on the screen, see this example:

```
Country Name (2 letter code) [AU]: AT
State or Province Name (full name) [Some-State]:Vienna
Locality Name (eg, city) []:Vienna
Organization Name (eg, company) [Internet Widgits Pty Ltd]: Proxmox GmbH
Organizational Unit Name (eg, section) []:Proxmox Mail Gateway
Common Name (eg, YOUR name) []: yourproxmox.yourdomain.com
Email Address []:support@yourdomain.com
```

```
Please enter the following 'extra' attributes to be sent with your ↵
certificate request
```

```
A challenge password []: not necessary
```

```
An optional company name []: not necessary
```

After you finished this certificate request you have to send the file `req.pem` to your Certification Authority (CA). The CA will issue the certificate (BASE64 encoded) based on your request – save this file as `cert.pem` to your Proxmox.

To activate the new certificate, do the following on your Proxmox:

```
cat key.pem cert.pem >/etc/pmg/pmg-api.pem
```

The restart the API servers

```
systemctl restart pmgproxy
```

Test your new certificate by using your browser.

Note

To transfer files from and to your Proxmox, you can use secure copy: If your desktop is Linux, you can use the `scp` command line tool. If your desktop PC is windows, please use a scp client like WinSCP (see <http://winscp.net/>).

A.1 Change Certificate for Cluster Setups

If you change the API certificate of an active cluster node, you also need to update the fingerprint inside the cluster configuration file `cluster.conf`. It is best to edit that file on the master node.

To show the actual fingerprint use:

```
openssl x509 -in /etc/pmg/pmg-api.pem -noout -fingerprint -sha256
```

Appendix B

Command Line Interface

B.1 pmgbackup - Proxmox Mail Gateway Backup and Restore Utility

pmgbackup <COMMAND> [ARGS] [OPTIONS]

pmgbackup backup [OPTIONS]

Backup the system configuration.

--statistic <boolean> (*default = 1*)
Backup statistic databases.

pmgbackup help [OPTIONS]

Get help about specified command.

--extra-args <array>
Shows help for a specific command

--verbose <boolean>
Verbose output format.

pmgbackup list

pmgbackup restore --filename <string> [OPTIONS]

Restore the system configuration.

--config <boolean> (*default = 0*)
Restore system configuration.

--database <boolean> (*default = 1*)
Restore the rule database. This is the default.

--filename pmg-backup_[0-9A-Za-z_-]+\ .tgz
The backup file name.

--statistic <boolean> (*default = 0*)
Restore statistic databases. Only considered when you restore the *database*.

B.2 pmgcm - Proxmox Mail Gateway Cluster Management Toolkit

pmgcm <COMMAND> [ARGS] [OPTIONS]

pmgcm create

Create initial cluster config with current node as master.

pmgcm delete <cid>

Remove a node from the cluster.

<cid>: <integer> (1 - N)
Cluster Node ID.

pmgcm help [OPTIONS]

Get help about specified command.

--extra-args <array>
Shows help for a specific command

--verbose <boolean>
Verbose output format.

pmgcm join <master_ip> [OPTIONS]

Join a new node to an existing cluster.

<master_ip>: <string>
IP address.

--fingerprint ^ (:?[A-Z0-9][A-Z0-9]:){31}[A-Z0-9][A-Z0-9]\$
SSL certificate fingerprint.

pmgcm join_cmd

Prints the command for joining an new node to the cluster. You need to execute the command on the new node.

pmgcm promote

Promote current node to become the new master.

pmgcm status [OPTIONS]

Cluster node status.

--list_single_node <boolean> (default = 0)
List local node if there is no cluster defined. Please note that RSA keys and fingerprint are not valid in that case.

pmgcm sync [OPTIONS]

Synchronize cluster configuration.

--master_ip <string>
Optional IP address for master node.

B.3 pmgsh - API Shell

Interactive session:

pmgsh

Directly call API functions:

pmgsh (get|set|create|help) <path> [OPTIONS]

B.4 pmgperf - Proxmox Simple Performance Benchmark

pmgperf help

pmgperf [<path>]

Proxmox benchmark.

<path>: <string> (default = /)
File system location to test.

B.5 pmgconfig - Configuration Management Toolkit

pmgconfig <COMMAND> [ARGS] [OPTIONS]

pmgconfig apicert [OPTIONS]

Generate /etc/pmg/pmg-api.pem (self signed certificate for GUI and REST API).

--force <boolean> (default = 0)
Overwrite existing certificate.

pmgconfig dkim_record

Get the public key for the configured selector, prepared as DKIM TXT record

pmgconfig dkim_set --keysize <integer> --selector <string> [OPTIONS]

Generate a new private key for selector. All future mail will be signed with the new key!

--keysize <integer> (1024 - N)
Number of bits for the RSA-Key

--selector <string>
DKIM Selector

pmgconfig dump

Print configuration setting which can be used in templates.

pmgconfig help [OPTIONS]

Get help about specified command.

--extra-args <array>
Shows help for a specific command

--verbose <boolean>
Verbose output format.

pmgconfig init

Generate required files in /etc/pmg/

pmgconfig ldapsync

Synchronize the LDAP database.

pmgconfig sync [OPTIONS]

Synchronize Proxmox Mail Gateway configurations with system configuration.

--restart <boolean> (default = 0)
Restart services if necessary.

pmgconfig tlscert [OPTIONS]

Generate /etc/pmg/pmg-tls.pem (self signed certificate for encrypted SMTP traffic).

--force <boolean> (default = 0)
Overwrite existing certificate.

B.6 pmgdb - Database Management Toolkit

pmgdb <COMMAND> [ARGS] [OPTIONS]

pmgdb delete

Delete PMG rule database.

pmgdb dump

Print the PMG rule database.

pmgdb help [OPTIONS]

Get help about specified command.

--extra-args <array>
Shows help for a specific command

--verbose <boolean>
Verbose output format.

pmgdb init [OPTIONS]

Initialize/Upgrade the PMG rule database.

--force <boolean> (default = 0)

Delete existing database.

--statistics <boolean> (default = 0)

Reset and update statistic database.

pmgdb reset

Reset PMG rule database back to factory defaults.

pmgdb update

Update the PMG statistic database.

Appendix C

Service Daemons

C.1 pmgdaemon - Proxmox Mail Gateway API Daemon

pmgdaemon <COMMAND> [ARGS] [OPTIONS]

pmgdaemon help [OPTIONS]

Get help about specified command.

--extra-args <array>

Shows help for a specific command

--verbose <boolean>

Verbose output format.

pmgdaemon restart

Restart the daemon (or start if not running).

pmgdaemon start [OPTIONS]

Start the daemon.

--debug <boolean> (*default = 0*)

Debug mode - stay in foreground

pmgdaemon status

Get daemon status.

pmgdaemon stop

Stop the daemon.

C.2 pmgproxy - Proxmox Mail Gateway API Proxy Daemon

pmgproxy <COMMAND> [ARGS] [OPTIONS]

pmgproxy help [OPTIONS]

Get help about specified command.

--extra-args <array>
Shows help for a specific command

--verbose <boolean>
Verbose output format.

pmgproxy restart

Restart the daemon (or start if not running).

pmgproxy start [OPTIONS]

Start the daemon.

--debug <boolean> (default = 0)
Debug mode - stay in foreground

pmgproxy status

Get daemon status.

pmgproxy stop

Stop the daemon.

C.3 pmg-smtp-filter - Proxmox SMTP Filter Daemon

Please use systemd tools to manage this service.

systemctl (start|stop|restart|reload|status) pmg-smtp-filter

C.4 pmgpolicy - Proxmox Mail Gateway Policy Daemon

Please use systemd tools to manage this service.

systemctl (start|stop|restart|reload|status) pmgpolicy

C.5 pmgtunnel - Cluster Tunnel Daemon

pmgtunnel <COMMAND> [ARGS] [OPTIONS]

pmgtunnel help [OPTIONS]

Get help about specified command.

--extra-args <array>
Shows help for a specific command

--verbose <boolean>
Verbose output format.

pmgtunnel restart

Restart the Cluster Tunnel Daemon

pmgtunnel start [OPTIONS]

Start the Cluster Tunnel Daemon

--debug <boolean> (default = 0)

Debug mode - stay in foreground

pmgtunnel status

Print cluster tunnel status.

pmgtunnel stop

Stop the Cluster Tunnel Daemon

C.6 pmgmirror - Database Mirror Daemon

pmgmirror <COMMAND> [ARGS] [OPTIONS]

pmgmirror help [OPTIONS]

Get help about specified command.

--extra-args <array>

Shows help for a specific command

--verbose <boolean>

Verbose output format.

pmgmirror restart

Restart the Database Mirror Daemon

pmgmirror start [OPTIONS]

Start the Database Mirror Daemon

--debug <boolean> (default = 0)

Debug mode - stay in foreground

pmgmirror stop

Stop the Database Mirror Daemon

Appendix D

Available Macros for the Rule System

It is possible to use macros inside most fields of action objects. That way it is possible to access and include data contained in the original mail, get envelope sender and receivers addresses or include additional information about Viruses and Spam. Currently the following macros are defined:

Macro	Comment
__SENDER__	(envelope) sender mail address
__RECEIVERS__	(envelope) receiver mail address list
__ADMIN__	Email address of the administrator
__TARGETS__	Subset of receivers matched by the rule
__SUBJECT__	Subject of the message
__MSGID__	The message ID
__RULE__	Name of the matching rule
__RULE_INFO__	Additional information about the matching rule

Macro	Comment
__VIRUS_INFO__	Additional information about detected viruses
__SPAMLEVEL__	Computed spam level
__SPAM_INFO__	Additional information why message is spam
__SENDER_IP__	IP address of sending host
__VERSION__	The current software version (proxmox mail gateway)
__FILENAME__	Attachment file name
__SPAMSTARS__	A series of "*" charactes where each one represents a full score (<i>SPAMLEVEL</i>) point

Appendix E

Configuration Files

E.1 Proxmox Mail Gateway Main Configuration

The file `/etc/pmg/pmg.conf` is the main configuration.

E.1.1 File Format

The file is divided into several section. Each section has the following format:

```
section: NAME
        OPTION value
        ...
```

Blank lines in the file separates sections, and lines starting with a `#` character are treated as comments and are also ignored.

E.1.2 Options

SECTION *admin*

advfilter: `<boolean>` (*default = 1*)

Use advanced filters for statistic.

avast: `<boolean>` (*default = 0*)

Use Avast Virus Scanner (`/usr/bin/scan`). You need to buy and install *Avast Core Security* before you can enable this feature.

clamav: `<boolean>` (*default = 1*)

Use ClamAV Virus Scanner. This is the default virus scanner and is enabled by default.

custom_check: `<boolean>` (*default = 0*)

Use Custom Check Script. The script has to take the defined arguments and can return Virus findings or a Spamscore.

custom_check_path: `^ / ([^\0]+\0)+ [^\0]+$ (default = /usr/local/bin/pmg-custom-check)`
Absolute Path to the Custom Check Script

dailyreport: `<boolean> (default = 1)`
Send daily reports.

demo: `<boolean> (default = 0)`
Demo mode - do not start SMTP filter.

dkim_selector: `<string>`
Default DKIM selector

dkim_sign: `<boolean> (default = 0)`
DKIM sign outbound mails with the configured Selector.

dkim_sign_all_mail: `<boolean> (default = 0)`
DKIM sign all outgoing mails irrespective of the Envelope From domain.

email: `<string> (default = admin@domain.tld)`
Administrator E-Mail address.

http_proxy: `http://.*`
Specify external http proxy which is used for downloads (example: `http://username:password@host:port/`)

statlifetime: `<integer> (1 - N) (default = 7)`
User Statistics Lifetime (days)

SECTION *clamav*

archiveblockencrypted: `<boolean> (default = 0)`
Whether to mark encrypted archives and documents as heuristic virus match. A match does not necessarily result in an immediate block, it just raises the Spam Score by `clamav_heuristic_score`.

archivemaxfiles: `<integer> (0 - N) (default = 1000)`
Number of files to be scanned within an archive, a document, or any other kind of container. Warning: disabling this limit or setting it too high may result in severe damage to the system.

archivemaxrec: `<integer> (1 - N) (default = 5)`
Nested archives are scanned recursively, e.g. if a ZIP archive contains a TAR file, all files within it will also be scanned. This options specifies how deeply the process should be continued. Warning: setting this limit too high may result in severe damage to the system.

archivemaxsize: `<integer> (1000000 - N) (default = 25000000)`
Files larger than this limit (in bytes) won't be scanned.

dbmirror: <string> (*default = database.clamav.net*)

ClamAV database mirror server.

maxcccount: <integer> (0 - N) (*default = 0*)

This option sets the lowest number of Credit Card or Social Security numbers found in a file to generate a detect.

maxscansize: <integer> (1000000 - N) (*default = 100000000*)

Sets the maximum amount of data (in bytes) to be scanned for each input file.

safebrowsing: <boolean> (*default = 1*)

Enables support for Google Safe Browsing.

SECTION *mail*

banner: <string> (*default = ESMTP Proxmox*)

ESMTP banner.

before_queue_filtering: <boolean> (*default = 0*)

Enable before queue filtering by pmg-smtp-filter

conn_count_limit: <integer> (0 - N) (*default = 50*)

How many simultaneous connections any client is allowed to make to this service. To disable this feature, specify a limit of 0.

conn_rate_limit: <integer> (0 - N) (*default = 0*)

The maximal number of connection attempts any client is allowed to make to this service per minute. To disable this feature, specify a limit of 0.

dnsbl_sites: <string>

Optional list of DNS white/blacklist domains (see `postscreen_dnsbl_sites` parameter).

dnsbl_threshold: <integer> (0 - N) (*default = 1*)

The inclusive lower bound for blocking a remote SMTP client, based on its combined DNSBL score (see `postscreen_dnsbl_threshold` parameter).

dwarning: <integer> (0 - N) (*default = 4*)

SMTP delay warning time (in hours).

ext_port: <integer> (1 - 65535) (*default = 25*)

SMTP port number for incoming mail (untrusted). This must be a different number than *int_port*.

greylist: <boolean> (*default = 1*)

Use Greylisting.

helotests: <boolean> (*default = 0*)

Use SMTP HELO tests.

hide_received: <boolean> (*default = 0*)

Hide received header in outgoing mails.

int_port: <integer> (1 - 65535) (*default = 26*)

SMTP port number for outgoing mail (trusted).

max_filters: <integer> (3 - 40) (*default = 35*)

Maximum number of pmg-smtp-filter processes.

max_policy: <integer> (2 - 10) (*default = 5*)

Maximum number of pmgpolicy processes.

max_smtpd_in: <integer> (3 - 100) (*default = 100*)

Maximum number of SMTP daemon processes (in).

max_smtpd_out: <integer> (3 - 100) (*default = 100*)

Maximum number of SMTP daemon processes (out).

maxsize: <integer> (1024 - N) (*default = 10485760*)

Maximum email size. Larger mails are rejected.

message_rate_limit: <integer> (0 - N) (*default = 0*)

The maximal number of message delivery requests that any client is allowed to make to this service per minute. To disable this feature, specify a limit of 0.

ndr_on_block: <boolean> (*default = 0*)

Send out NDR when mail gets blocked

rejectunknown: <boolean> (*default = 0*)

Reject unknown clients.

rejectunknownsender: <boolean> (*default = 0*)

Reject unknown senders.

relay: <string>

The default mail delivery transport (incoming mails).

relaynomx: <boolean> (*default = 0*)

Disable MX lookups for default relay.

relayport: <integer> (1 - 65535) (*default = 25*)

SMTP port number for relay host.

smarthost: <string>

When set, all outgoing mails are delivered to the specified smarthost.

smarthostport: <integer> (1 - 65535) (default = 25)

SMTP port number for smarthost.

spf: <boolean> (default = 1)

Use Sender Policy Framework.

tls: <boolean> (default = 0)

Enable TLS.

tlsheader: <boolean> (default = 0)

Add TLS received header.

tlslog: <boolean> (default = 0)

Enable TLS Logging.

verifyreceivers: <450 | 550>

Enable receiver verification. The value specifies the numerical reply code when the Postfix SMTP server rejects a recipient address.

SECTION *spam*

bounce_score: <integer> (0 - 1000) (default = 0)

Additional score for bounce mails.

clamav_heuristic_score: <integer> (0 - 1000) (default = 3)

Score for ClamAV heuristics (Encrypted Archives/Documents, Google Safe Browsing database, PhishingScanURLs, ...).

languages: (all | ([a-z][a-z])+(([a-z][a-z])+)*) (default = all)

This option is used to specify which languages are considered OK for incoming mail.

maxspamsize: <integer> (64 - N) (default = 262144)

Maximum size of spam messages in bytes.

rbl_checks: <boolean> (default = 1)

Enable real time blacklists (RBL) checks.

use_awl: <boolean> (default = 1)

Use the Auto-Whitelist plugin.

use_bayes: <boolean> (default = 1)

Whether to use the naive-Bayesian-style classifier.

use_razor: <boolean> (default = 1)

Whether to use Razor2, if it is available.

wl_bounce_relays: <string>
Whitelist legitimate bounce relays.

SECTION *spamquar*

allowhrefs: <boolean> (*default = 1*)
Allow to view hyperlinks.

authmode: <ldap | ldapticket | ticket> (*default = ticket*)
Authentication mode to access the quarantine interface. Mode *ticket* allows login using tickets sent with the daily spam report. Mode *ldap* requires to login using an LDAP account. Finally, mode *ldapticket* allows both ways.

hostname: <string>
Quarantine Host. Useful if you run a Cluster and want users to connect to a specific host.

lifetime: <integer> (1 - N) (*default = 7*)
Quarantine life time (days)

mailfrom: <string>
Text for *From* header in daily spam report mails.

port: <integer> (1 - 65535) (*default = 8006*)
Quarantine Port. Useful if you have a reverse proxy or port forwarding for the webinterface. Only used for the generated Spam report.

protocol: <http | https> (*default = https*)
Quarantine Webinterface Protocol. Useful if you have a reverse proxy for the webinterface. Only used for the generated Spam report.

reportstyle: <custom | none | short | verbose> (*default = verbose*)
Spam report style.

viewimages: <boolean> (*default = 1*)
Allow to view images.

SECTION *virusquar*

allowhrefs: <boolean> (*default = 1*)
Allow to view hyperlinks.

lifetime: <integer> (1 - N) (*default = 7*)
Quarantine life time (days)

viewimages: <boolean> (*default = 1*)
Allow to view images.

E.2 Cluster Configuration

The file `/etc/pmg/cluster.conf` contains the cluster configuration.

E.2.1 File Format

The file is divided into several section. There is one *master* and several *node* sections.

```
master: <cid>
        OPTION value
        ...

node: <cid>
        OPTION value
        ...
```

Blank lines in the file separates sections, and lines starting with a `#` character are treated as comments and are also ignored.

E.2.2 Options

cid: <integer> (1 - N)
Cluster Node ID.

fingerprint: `^(:? [A-Z0-9] [A-Z0-9] :) {31} [A-Z0-9] [A-Z0-9] $`
SSL certificate fingerprint.

hostrsapubkey: `^[A-Za-z0-9\.\ \/ \+]{200,}$`
Public SSH RSA key for the host.

ip: <string>
IP address.

maxcid: <integer> (1 - N)
Maximum used cluster node ID (used internally, do not modify).

name: <string>
Node name.

rootrsapubkey: `^[A-Za-z0-9\.\ \/ \+]{200,}$`
Public SSH RSA key for the root user.

E.3 User Configuration

The file `/etc/pmg/user.conf` contains the user configuration.

E.4 LDAP Configuration

The file `/etc/pmg/ldap.conf` contains the LDAP configuration.

E.4.1 File Format

The file is divided into a section for each LDAP profile. Each section has the following format:

```
ldap: NAME
      OPTION value
      ...
```

Blank lines in the file separates sections, and lines starting with a `#` character are treated as comments and are also ignored.

E.4.2 Options

accountattr: `<string>` (*default = sAMAccountName, uid*)

Account attribute name.

basedn: `<string>`

Base domain name.

binddn: `<string>`

Bind domain name.

bindpw: `<string>`

Bind password.

cafile: `<string>`

Path to CA file. Only useful with option *verify*

comment: `<string>`

Description.

disable: `<boolean>`

Flag to disable/deactivate the entry.

filter: `<string>`

LDAP filter.

groupbasedn: `<string>`

Base domain name for groups.

groupclass: <string> (*default = group, univentionGroup, ipausergroup*)
List of objectclasses for groups.

mailattr: <string> (*default = mail, userPrincipalName, proxyAddresses, othermailbox, mailAlternativeAddress*)
List of mail attribute names.

mode: <ldap | ldap+starttls | ldaps> (*default = ldap*)
LDAP protocol mode (*ldap, ldaps or ldap+starttls*).

port: <integer> (1 - 65535)
Specify the port to connect to.

profile: <string>
Profile ID.

server1: <string>
Server address.

server2: <string>
Fallback server address. Used when the first server is not available.

verify: <boolean> (*default = 0*)
Verify server certificate. Only useful with ldaps or ldap+starttls.

Appendix F

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