

## **Virtual Mail Sever Report**

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## Abstract

This report will cover how our team was able to set up a virtual mail server on a Linux Ubuntu Server. On our virtual mail server, we were able to configure services like Postfix, Dovecot, MySQL, Amavis, and Clam AV. This allowed us to create the foundation for our virtual mail server. These steps established groundwork for integrating security protocols and spam protection for systems. Below are screenshots and a description of each part of the project to showcase what was completed.

## Research Approach

### *History*

The origins of virtual mail servers began in 1971 when the first email was sent across the ARPANET by Ray Tomlinson. He introduced using the “@” symbol to distinguish between the users and the host name. As time went on protocols like the Simple Mail Transfer Protocol (SMTP) were created and implemented on ARPNET to build a framework on how emails should be delivered in 1983. Then by the 1990’s the internet began to expand quickly, and businesses needed a scalable solution to manage emails for multiple domains and users. This led to the development of virtual mail servers, these systems were able to host emails services for multiple domains on a single physical server. These servers also used virtual domains to separate email traffic which allows hosting systems without having to deploy separate hardware for each domain. Over time as threats like viruses and spam grew in the early 2000’s virtual email servers evolved to include advanced security features like SMTP authentication and Transport Layer Security (TLS). Tools like Amavis and ClamAV were created to scan systems for viruses and

filter spam messages. Today, virtual mail servers are essential infrastructure for hosting email for different industries.

### ***How it was gotten***

For our UNIX Administration class, our team was assigned to set up a virtual mail server. We chose this project because it ties together core system admin skills like DNS setup, mail transport protocols, database integration, and security tools. We worked with Postfix, Dovecot, MySQL, Amavis, and ClamAV. It wasn't just about installing packages. We had to troubleshoot real issues like authentication errors and missing dependencies, and figure out how each component fits into the bigger picture. This gave us practical experience and helped us understand how to build a secure, working mail system from the ground up.

### **Results**

Virtual mail servers perform the same functions as traditional mail servers, but they operate within a virtualized environment. Despite not running directly on physical hardware, virtual mail servers maintain comparable performance and reliability. They offer societal benefits due to their low maintenance requirements and high functionality. According to Faizan et al. (2020), "The main advantage of virtual mail servers is that they are scalable, and they have their dedicated core and memory allocation. They bring down the installation and maintenance costs. They significantly reduce downtime. They can also be completely customized." These features benefit companies by reducing costs and simplifying installation, thanks to scalability. Users also benefit from minimal downtime, which ensures consistent access to email services.

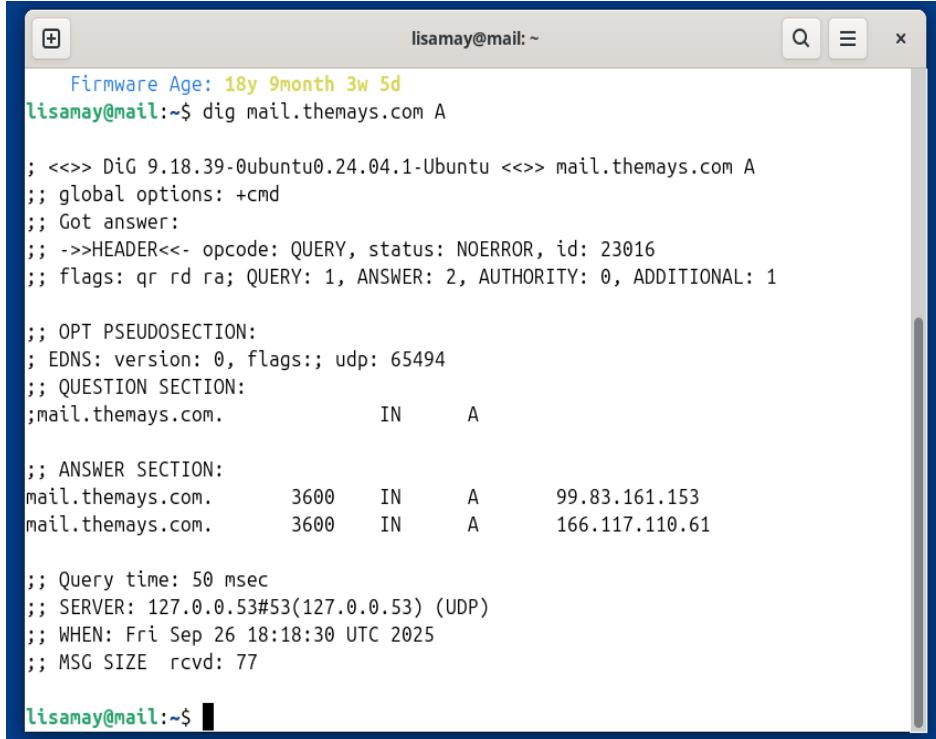
Below are the screenshots of the process we followed to configure the virtual mail server.

## Part 1: Checking Prerequisites

Before configuring the mail server, the server software and system packages were updated. This ensures the system is equipped with the latest security patches, maintains compatibility with mail services, and operates efficiently to support reliable email delivery. After the upgrades and updates were completed, the server was manually configured for DNS. This included configuring an A record to point *mail.themays.com* to the server's public IP address, and an MX record to designate it as the mail handler for the domain.

```
lisamay@lisamayserver:~$ sudo hostnamectl set-hostname mail.themays.com
lisamay@lisamayserver:~$ hostnamectl
Static hostname: mail.themays.com
Icon name: computer-vm
Chassis: vm
Machine ID: 4a24808c6fc543f6b9d9b53f9b1d9481
Boot ID: 61af377580c148499b2d95e23a5c82d5
Virtualization: oracle
Operating System: Ubuntu 24.04.3 LTS
Kernel: Linux 6.8.0-84-generic
Architecture: x86-64
Hardware Vendor: innotek GmbH
Hardware Model: VirtualBox
Firmware Version: VirtualBox
Firmware Date: Fri 2006-12-01
Firmware Age: 18y 9month 3w 5d
lisamay@lisamayserver:~$
```

Figure 1- Hostname



The screenshot shows a terminal window titled "lisamay@mail:~". The window displays the output of a "dig" command for the "A" record of the domain "mail.themays.com". The output includes the following information:

```
Firmware Age: 18y 9month 3w 5d
lisamay@mail:~$ dig mail.themays.com A

; <>> DiG 9.18.39-0ubuntu0.24.04.1-Ubuntu <>> mail.themays.com A
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 23016
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 1

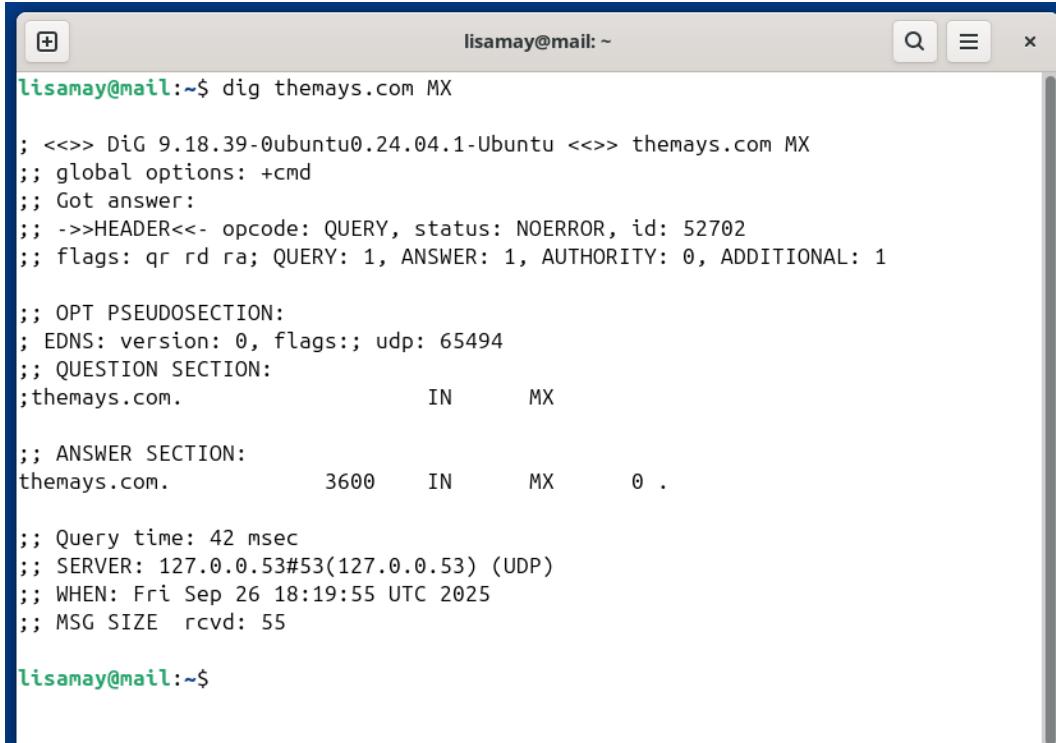
;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;mail.themays.com.           IN      A

;; ANSWER SECTION:
mail.themays.com.      3600    IN      A      99.83.161.153
mail.themays.com.      3600    IN      A      166.117.110.61

;; Query time: 50 msec
;; SERVER: 127.0.0.53#53(127.0.0.53) (UDP)
;; WHEN: Fri Sep 26 18:18:30 UTC 2025
;; MSG SIZE  rcvd: 77

lisamay@mail:~$
```

Figure 2- A record



```

lisamay@mail:~$ dig themays.com MX

; <>>> DiG 9.18.39-0ubuntu0.24.04.1-Ubuntu <>> themays.com MX
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 52702
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;themays.com.           IN      MX

;; ANSWER SECTION:
themays.com.        3600    IN      MX      0  .

;; Query time: 42 msec
;; SERVER: 127.0.0.53#53(127.0.0.53) (UDP)
;; WHEN: Fri Sep 26 18:19:55 UTC 2025
;; MSG SIZE  rcvd: 55

lisamay@mail:~$
```

Figure 3 - MX records

## Part 2: Installing Required Software Packages

Once DNS was configured and the system was updated, the following software packages were installed to support the mail server: Postfix, MySQL, Dovecot, ClamAV Daemon, and Amavisd. These components work to allow for mail transport, user authentication, spam filtering, and virus scanning. To check if the service was active and enabled, the command ***systemctl status*** was used.

```
lines 1-23

lisamay@mail:~$ systemctl status amavis
● amavis.service - Interface between MTA and virus scanner/content filters
  Loaded: loaded (/usr/lib/systemd/system/amavis.service; enabled; preset: en>
  Active: active (running) since Fri 2025-09-26 18:33:06 UTC; 4min 41s ago
    Docs: http://www.ijs.si/software/amavisd/#doc
  Main PID: 10194 (/usr/sbin/amavi)
     Tasks: 3 (limit: 4821)
    Memory: 58.1M (peak: 62.4M)
      CPU: 1.824s
     CGroup: /system.slice/amavis.service
             └─10194 "/usr/sbin/amavisd (master)"
                 ├─10247 "/usr/sbin/amavisd (virgin child)"
                 ├─10248 "/usr/sbin/amavisd (virgin child)"

Sep 26 18:33:09 mail.themays.com amavis[10194]: No decoder for .iso
Sep 26 18:33:09 mail.themays.com amavis[10194]: No decoder for .jar
Sep 26 18:33:09 mail.themays.com amavis[10194]: No decoder for .lha
Sep 26 18:33:09 mail.themays.com amavis[10194]: No decoder for .lrz
Sep 26 18:33:09 mail.themays.com amavis[10194]: No decoder for .lz4
Sep 26 18:33:09 mail.themays.com amavis[10194]: No decoder for .lzo
Sep 26 18:33:09 mail.themays.com amavis[10194]: No decoder for .rar
Sep 26 18:33:09 mail.themays.com amavis[10194]: No decoder for .rpm
```

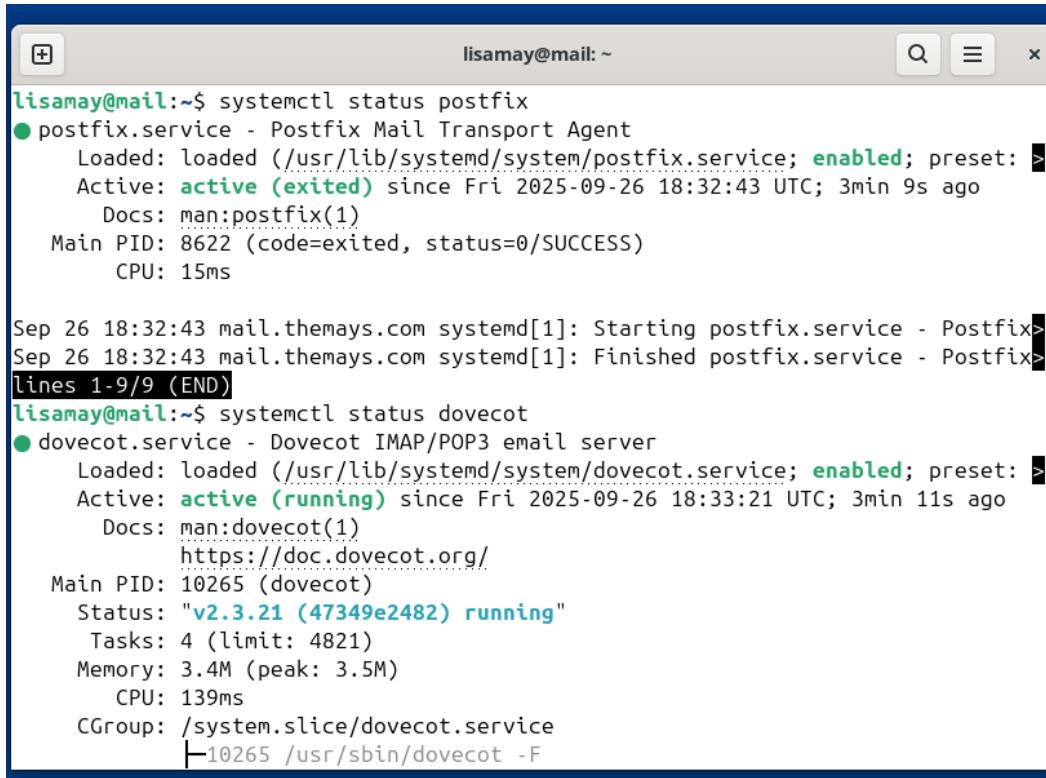
Figure 4 - Status of Amavis

```
lisamay@mail:~$ systemctl status mysql
● mysql.service - MySQL Community Server
  Loaded: loaded (/usr/lib/systemd/system/mysql.service; enabled; preset: en>
  Active: active (running) since Fri 2025-09-26 18:32:04 UTC; 4min 49s ago
  Main PID: 7504 (mysqld)
    Status: "Server is operational"
     Tasks: 37 (limit: 4821)
    Memory: 363.7M (peak: 378.0M)
      CPU: 11.191s
     CGroup: /system.slice/mysql.service
             └─7504 /usr/sbin/mysqld

Sep 26 18:31:59 mail.themays.com systemd[1]: Starting mysql.service - MySQL Com>
Sep 26 18:32:04 mail.themays.com systemd[1]: Started mysql.service - MySQL Com>
lines 1-13/13 (END)

lisamay@mail:~$ systemctl clamav-daemon
Unknown command verb 'clamav-daemon'.
lisamay@mail:~$ systemctl status clamav-daemon
● clamav-daemon.service - Clam AntiVirus userspace daemon
  Loaded: loaded (/usr/lib/systemd/system/clamav-daemon.service; enabled; pr>
  Drop-In: /etc/systemd/system/clamav-daemon.service.d
            └─extend.conf
  Active: inactive (dead)
```

Figure 5- Status of MySQL and Clamav



```

lisamay@mail:~$ systemctl status postfix
● postfix.service - Postfix Mail Transport Agent
  Loaded: loaded (/usr/lib/systemd/system/postfix.service; enabled; preset: >
  Active: active (exited) since Fri 2025-09-26 18:32:43 UTC; 3min 9s ago
    Docs: man:postfix(1)
   Main PID: 8622 (code=exited, status=0/SUCCESS)
     CPU: 15ms

Sep 26 18:32:43 mail.themays.com systemd[1]: Starting postfix.service - Postfix>
Sep 26 18:32:43 mail.themays.com systemd[1]: Finished postfix.service - Postfix>
lines 1-9/9 (END)

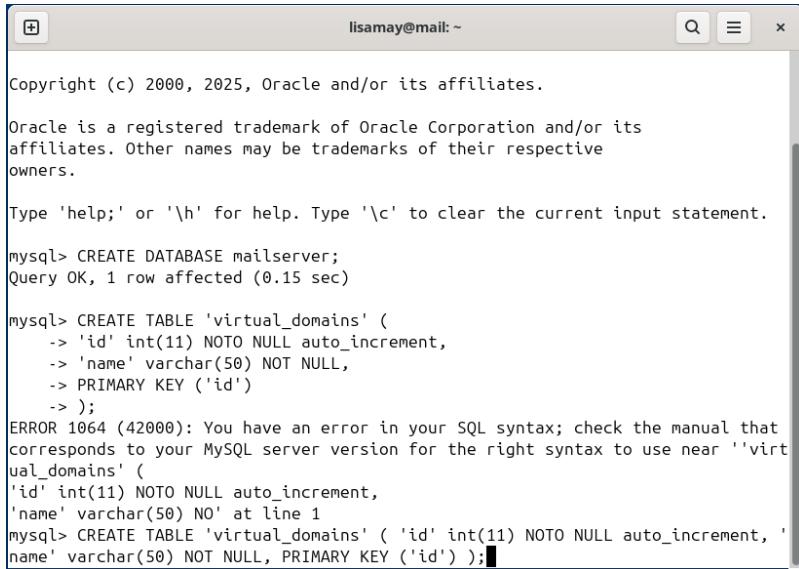
lisamay@mail:~$ systemctl status dovecot
● dovecot.service - Dovecot IMAP/POP3 email server
  Loaded: loaded (/usr/lib/systemd/system/dovecot.service; enabled; preset: >
  Active: active (running) since Fri 2025-09-26 18:33:21 UTC; 3min 11s ago
    Docs: man:dovecot(1)
          https://doc.dovecot.org/
   Main PID: 10265 (dovecot)
     Status: "v2.3.21 (47349e2482) running"
       Tasks: 4 (limit: 4821)
      Memory: 3.4M (peak: 3.5M)
        CPU: 139ms
      CGroup: /system.slice/dovecot.service
              └─10265 /usr/sbin/dovecot -F

```

Figure 6- Status of Postfix and Dovecot

### Part 3: Configuring MySQL and Connecting it with Postfix

To manage virtual domains and users, MySQL was configured and integrated with Postfix. A database named ***mailserver*** was created, along with the following tables: ***virtual\_domains***, ***users***, and ***aliases***. These tables will ensure that domain routing works properly, users can authenticate through the database, and aliases handle any mail forwarding or redirection.



```

lisamay@mail: ~
Copyright (c) 2000, 2025, Oracle and/or its affiliates.

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affiliates. Other names may be trademarks of their respective
owners.

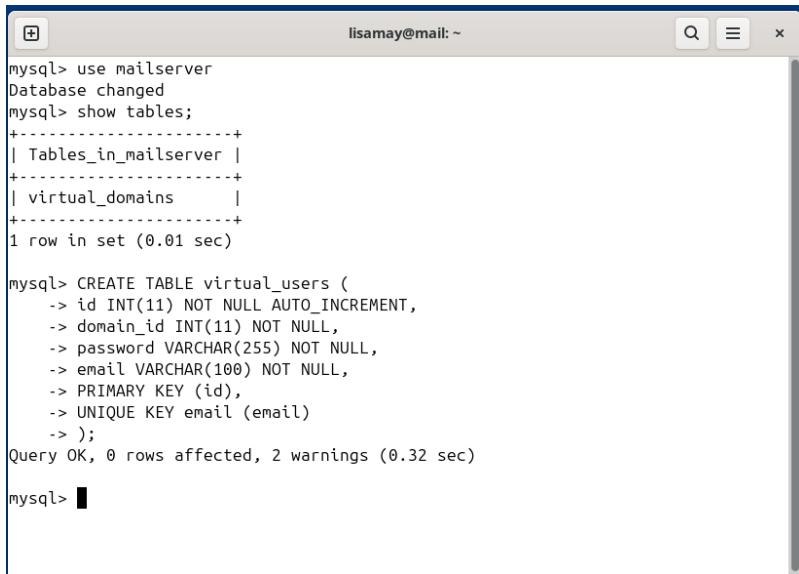
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> CREATE DATABASE mailserver;
Query OK, 1 row affected (0.15 sec)

mysql> CREATE TABLE 'virtual_domains' (
-> 'id' int(11) NOT NULL auto_increment,
-> 'name' varchar(50) NOT NULL,
-> PRIMARY KEY ('id')
-> );
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that
corresponds to your MySQL server version for the right syntax to use near ''virt
ual_domains' (
'id' int(11) NOT NULL auto_increment,
'name' varchar(50) NO' at line 1
mysql> CREATE TABLE 'virtual_domains' ( 'id' int(11) NOT NULL auto_increment, 'name' varchar(50) NOT NULL, PRIMARY KEY ('id') );

```

Figure 7 - DB creation and Virtual Domain



```

lisamay@mail: ~
mysql> use mailserver
Database changed
mysql> show tables;
+-----+
| Tables_in_mailserver |
+-----+
| virtual_domains      |
+-----+
1 row in set (0.01 sec)

mysql> CREATE TABLE virtual_users (
-> id INT(11) NOT NULL AUTO_INCREMENT,
-> domain_id INT(11) NOT NULL,
-> password VARCHAR(255) NOT NULL,
-> email VARCHAR(100) NOT NULL,
-> PRIMARY KEY (id),
-> UNIQUE KEY email (email)
-> );
Query OK, 0 rows affected, 2 warnings (0.32 sec)

mysql> 

```

Figure 8- Table for Virtual Users

```

lisamay@mail: ~
mysql> get tables;
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that
corresponds to your MySQL server version for the right syntax to use near 'table
s' at line 1
mysql> show tables;
+-----+
| Tables_in_mailserver |
+-----+
| virtual_domains      |
| virtual_users         |
+-----+
2 rows in set (0.03 sec)

mysql> CREATE TABLE virtual_aliases (
    -> id INT(11) NOT NULL AUTO_INCREMENT,
    -> domain_id INT(11) NOT NULL,
    -> source VARCHAR(100) NOT NULL,
    -> destination VARCHAR(100) NOT NULL,
    -> PRIMARY KEY (id),
    -> FOREIGN KEY (domain_id) REFERENCES virtual_domains(id) ON DELETE CASCADE
    -> );
Query OK, 0 rows affected, 2 warnings (0.35 sec)

mysql> ■

```

Figure 9 - Table for Virtual Aliases

Afterwards, a user was created for the purpose of interacting with the database. Doing so will allow Postfix to query MySQL for information about the domain, users, and aliases. Without a user, it would not be able to connect to the mail server database to query or verify anything.

```

lisamay@mail: ~
lisamay@mail: ~
mysql> CREATE USER 'mailuser'@"localhost" IDENTIFIED BY 'cT3cMaily23!';
      ">>
      ">>
      ">>
      ">> ^C
mysql> CREATE USER 'mailuser'@"localhost" IDEENTIFIED BY 'cT3cMaily23!';
ERROR 1064 (42000): You have an error in your SQL syntax; check the manual that
corresponds to your MySQL server version for the right syntax to use near 'IDEEN
TIIFIED BY 'cT3cMaily23!'' at line 1
mysql> CREATE USER 'mailuser'@"localhost" IDENTIFIED BY 'cT3cMaily23!';
Query OK, 0 rows affected (0.21 sec)

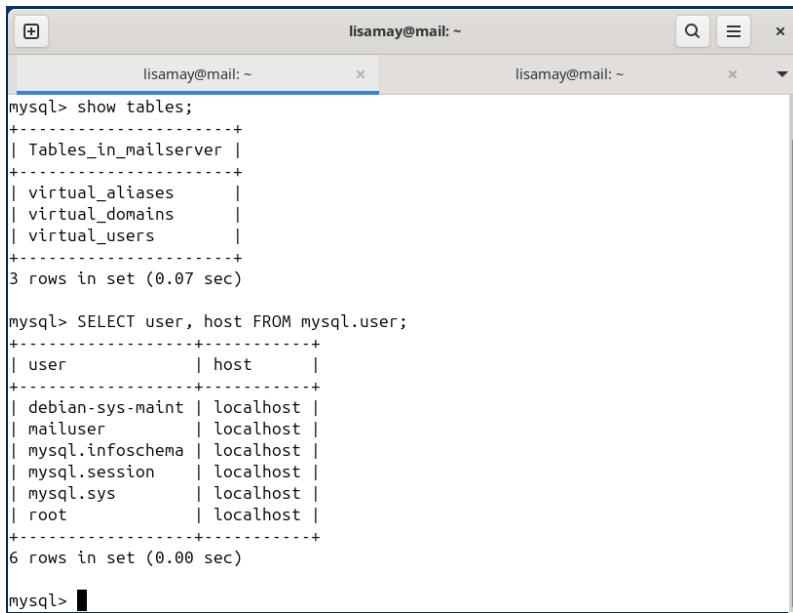
mysql> GRANT SELECT ON mailserver.* TO 'mailserver'@'localhost';
ERROR 1410 (42000): You are not allowed to create a user with GRANT
mysql> GRANT SELECT ON mailserver.* TO 'mailuser'@'localhost';
Query OK, 0 rows affected (0.06 sec)

mysql> FLUSH PRIVILEGES
-> ^C
mysql> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.02 sec)

mysql> ■

```

Figure 10 - User creation



The screenshot shows a terminal window with two tabs open, both titled 'lisamay@mail: ~'. The left tab displays the output of the MySQL command 'show tables;'. The right tab displays the output of the MySQL command 'SELECT user, host FROM mysql.user;'. Both commands were run by the user 'lisamay'.

```
mysql> show tables;
+-----+
| Tables_in_mailserver |
+-----+
| virtual_aliases      |
| virtual_domains       |
| virtual_users         |
+-----+
3 rows in set (0.07 sec)

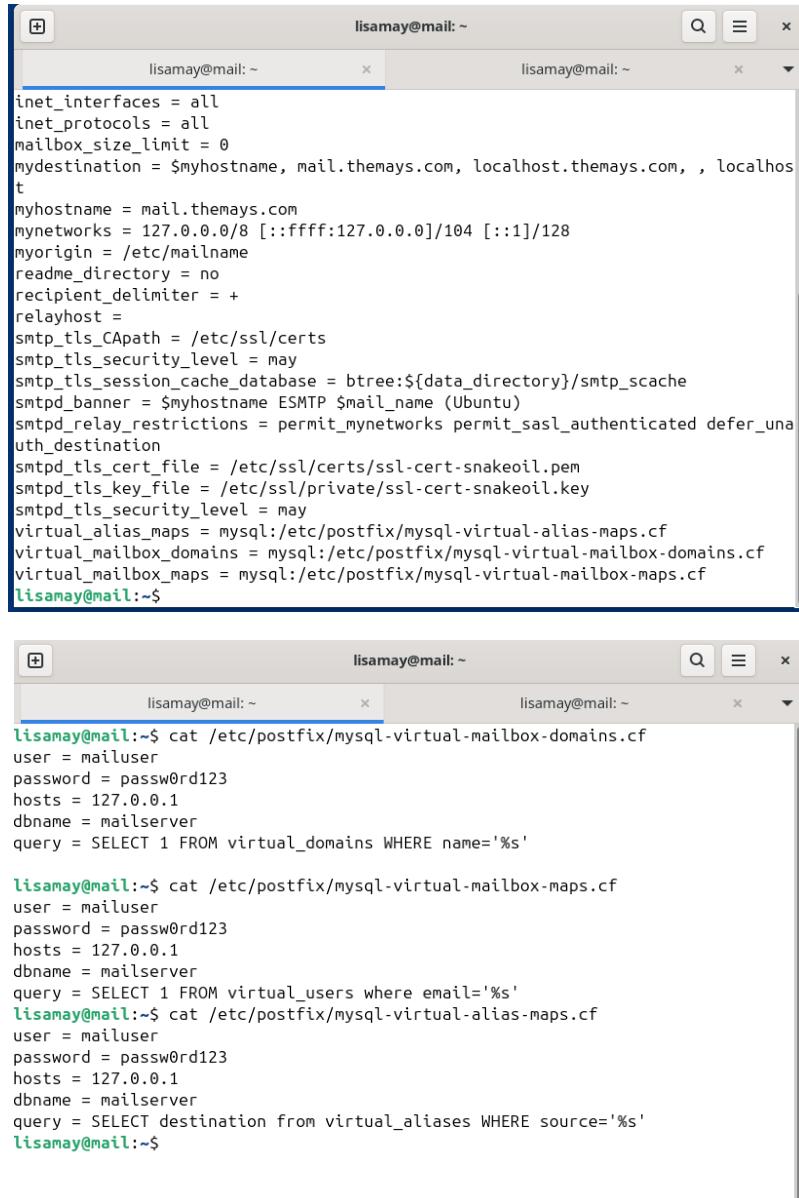
mysql> SELECT user, host FROM mysql.user;
+-----+-----+
| user      | host   |
+-----+-----+
| debian-sys-maint | localhost |
| mailuser    | localhost |
| mysql.infoschema | localhost |
| mysql.session   | localhost |
| mysql.sys     | localhost |
| root        | localhost |
+-----+-----+
6 rows in set (0.00 sec)

mysql>
```

Figure 11 - Tables and Users

#### Part 4: Configuring Postfix Using Postconfig Command

To configure Postfix to handle virtual domains and users, the ***postconf*** command was used to point Postfix to MySQL lookup files. These files contain the queries and credentials needed to pull domain, user, and alias data from the mailserver database.



```

lisanay@mail:~$ cat /etc/postfix/mysql-virtual-mailbox-domains.cf
user = mailuser
password = passw0rd123
hosts = 127.0.0.1
dbname = mailserver
query = SELECT 1 FROM virtual_domains WHERE name='%s'

lisanay@mail:~$ cat /etc/postfix/mysql-virtual-mailbox-maps.cf
user = mailuser
password = passw0rd123
hosts = 127.0.0.1
dbname = mailserver
query = SELECT 1 FROM virtual_users where email='%s'
lisanay@mail:~$ cat /etc/postfix/mysql-virtual-alias-maps.cf
user = mailuser
password = passw0rd123
hosts = 127.0.0.1
dbname = mailserver
query = SELECT destination from virtual_aliases WHERE source='%s'
lisanay@mail:~$
```

## Part 5: Configuring SMTP AUTH (SASLAUTHD and MySQL)

Enabling SMTP authentication prevents unauthorized users from sending mail through the server. Without SMTP authentication, unwanted mail, such as spam, may get through. This will require users to sign in before they are able to send mail. If the user does not have valid credentials, they will not be able to send mail through the server.

```

lisamay@mail:~$ sudo systemctl restart saslauthd postfix
lisamay@mail:~$ sudo systemctl status saslauthd
● saslauthd.service - SASL Authentication Daemon
   Loaded: loaded (/usr/lib/systemd/system/saslauthd.service; disabled; presen
   Active: active (running) since Fri 2025-09-26 23:12:31 UTC; 43s ago
     Docs: man:saslauthd(8)
  Process: 13677 ExecStart=/usr/sbin/saslauthd -a $MECHANISMS $MECH_OPTIONS $>
 Main PID: 13679 (saslauthd)
    Tasks: 5 (limit: 4821)
   Memory: 3.0M (peak: 3.3M)
      CPU: 43ms
     CGroupl: /system.slice/saslauthd.service
             └─13679 /usr/sbin/saslauthd -a pam -c -m /var/run/saslauthd -n 5
               ├─13680 /usr/sbin/saslauthd -a pam -c -m /var/run/saslauthd -n 5
               ├─13682 /usr/sbin/saslauthd -a pam -c -m /var/run/saslauthd -n 5
               ├─13683 /usr/sbin/saslauthd -a pam -c -m /var/run/saslauthd -n 5
               └─13685 /usr/sbin/saslauthd -a pam -c -m /var/run/saslauthd -n 5

Sep 26 23:12:31 mail.themays.com systemd[1]: Starting saslauthd.service - SASL
Sep 26 23:12:31 mail.themays.com saslauthd[13679]:                         : master pid
Sep 26 23:12:31 mail.themays.com saslauthd[13679]:                         : listening
Sep 26 23:12:31 mail.themays.com systemd[1]: Started saslauthd.service - SASL A
lines 1-20/20 (END)

```

## Future Work

This project builds a solid foundation for learning how to build a virtual mail server using a Linux based system. But there are still a number of opportunities for further research and advancement. This could include incorporating advanced threat protection in systems. Maybe implementing AI to help with spam and virus filtering. Especially at universities since college students are targeted frequently. Email systems automatically have banners that alert you saying this email originated outside of the organization. But those banners are applied to almost all of student's emails. So, students tend to disregard those messages. The software is also not accurate when it comes to categorizing or filtering out malicious emails. Students are often misled by emails focused on refund checks and financial aid. More research could be done to help prevent these types of attacks, so students won't even see these types of emails. Then AI models could also be incorporated to categorize emails based on the user's interest. This would reduce clutter and focus on important messages in the user's email.

## Conclusion

With the help of essential components like Postfix, Dovecot, MySQL, Amavis, and ClamAV, in this project, we successfully deployed and configured a virtual mail server on a Linux Ubuntu platform, guaranteeing reliable mail delivery and security. Through practical troubleshooting and system integration, our team gained important real-world experience in user authentication, virtual domain management, and virus and spam prevention. This work not only achieves important technical goals but also emphasizes the growing significance of virtual mail servers in the current digital communication.

## References

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