



POSTFIX

Postfix and Dovecot

tsaimh (2024-2026, CC-BY)

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? (?-2019)



Postfix

Source: <http://www.porcupine.org/wietse/>

- Postfix is **Wietse Venema**'s mail server that started life at **IBM research** as an alternative to the widely-used **Sendmail** program.
- The software is also known by its former names **VMailer** and **IBM Secure Mailer**.
- The name **Postfix** is a compound of "**post**" (i.e., mail) and "**bugfix**" (for other software that inspired Postfix development).
- Postfix attempts to be **fast, easy to administer, and secure**.
- The **outside** has a definite **Sendmail-ish flavor**, but the **inside** is **completely different**.



Wietse Zweitze Venema

[Pronunciation](#)

Postfix (cont.)

- In the eight years at **Google**, Wietse continues to maintain Postfix.
- Postfix versions
 - First released in December 1998
 - Latest stable release: 3.11.1 (March 10, 2026 release)
 - `/usr/ports/mail/postfix`
 - `pkg install postfix`
- <http://www.postfix.org>
 - <http://www.postfix.org/documentation.html>

```
HISTORY
    The postqueue command was introduced with Postfix version 1.1.

AUTHOR(S)
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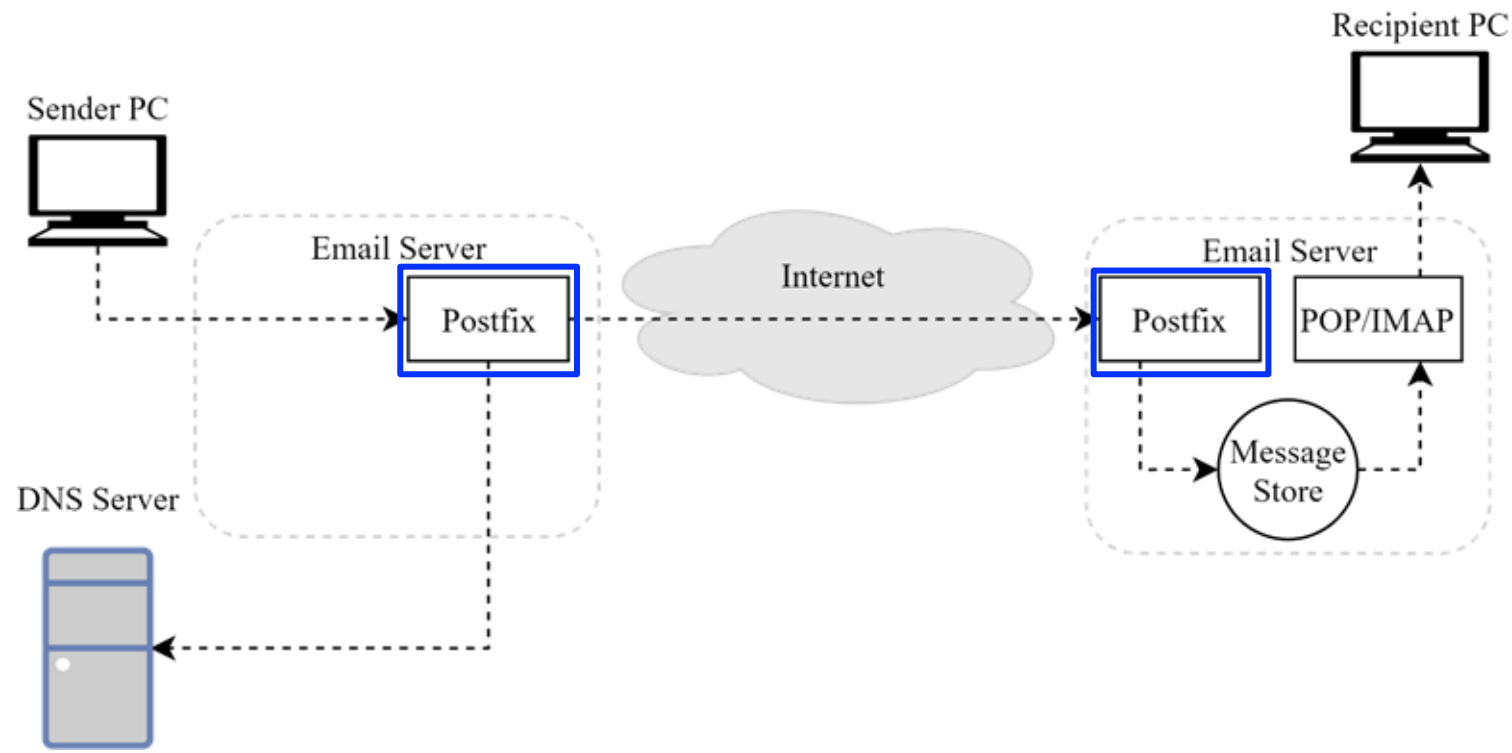
    Wietse Venema
    Google, Inc.
    111 8th Avenue
    New York, NY 10011, USA

(END)                                     POSTQUEUE(1)
```

Source: man page of `postqueue(1)`

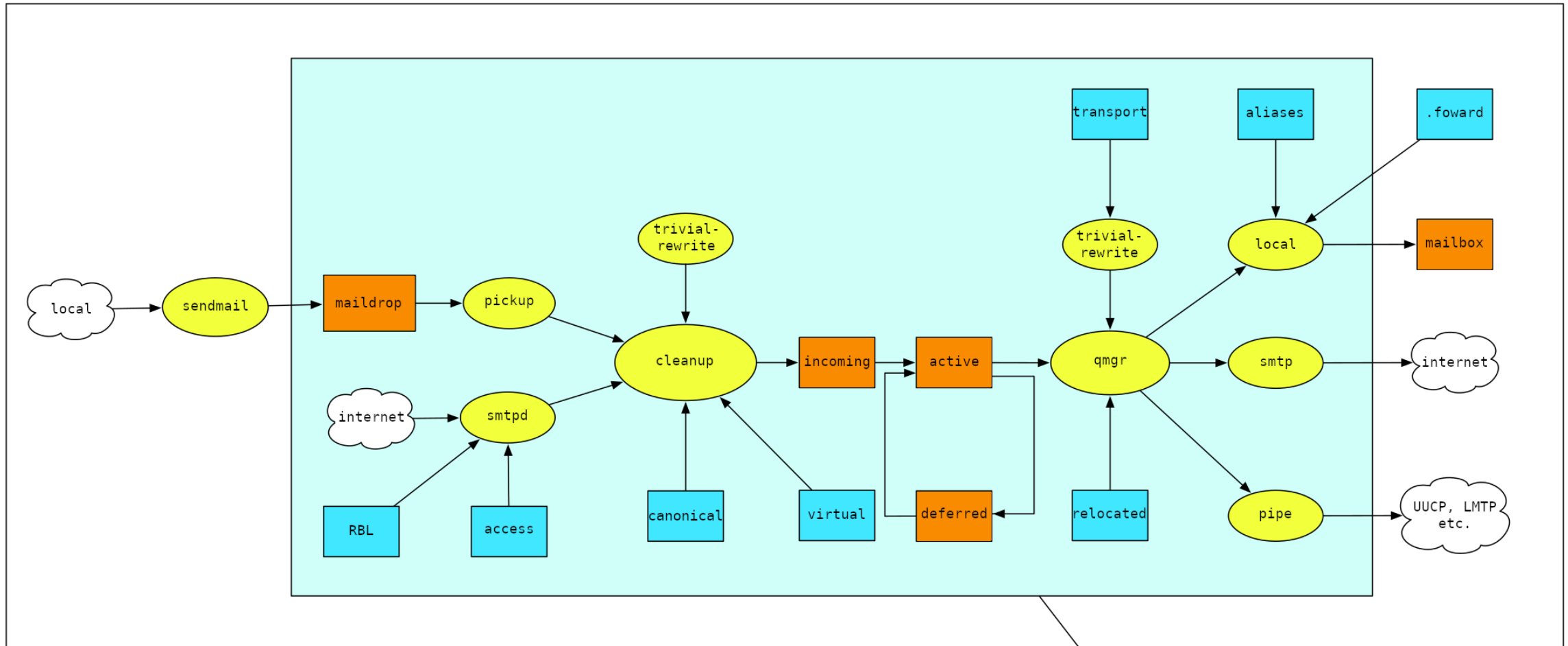
Role of Postfix

- MTA that
 - Receive and deliver email over the network (SMTP)
 - Local delivery
 - <http://www.postfix.org/OVERVIEW.html>



Postfix Architecture

Source [https://en.wikipedia.org/wiki/Postfix_\(software\)](https://en.wikipedia.org/wiki/Postfix_(software))



Legend:

Lookup table

Mail programs

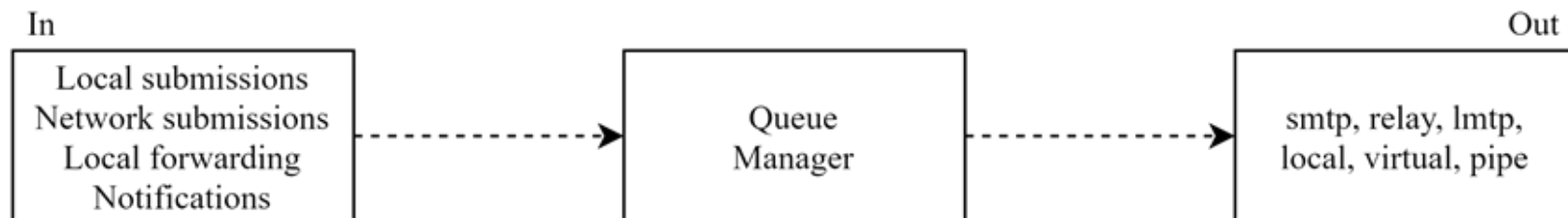
Mail queues or files

Controlled by Postfix master daemon

Postfix Architecture (cont.)

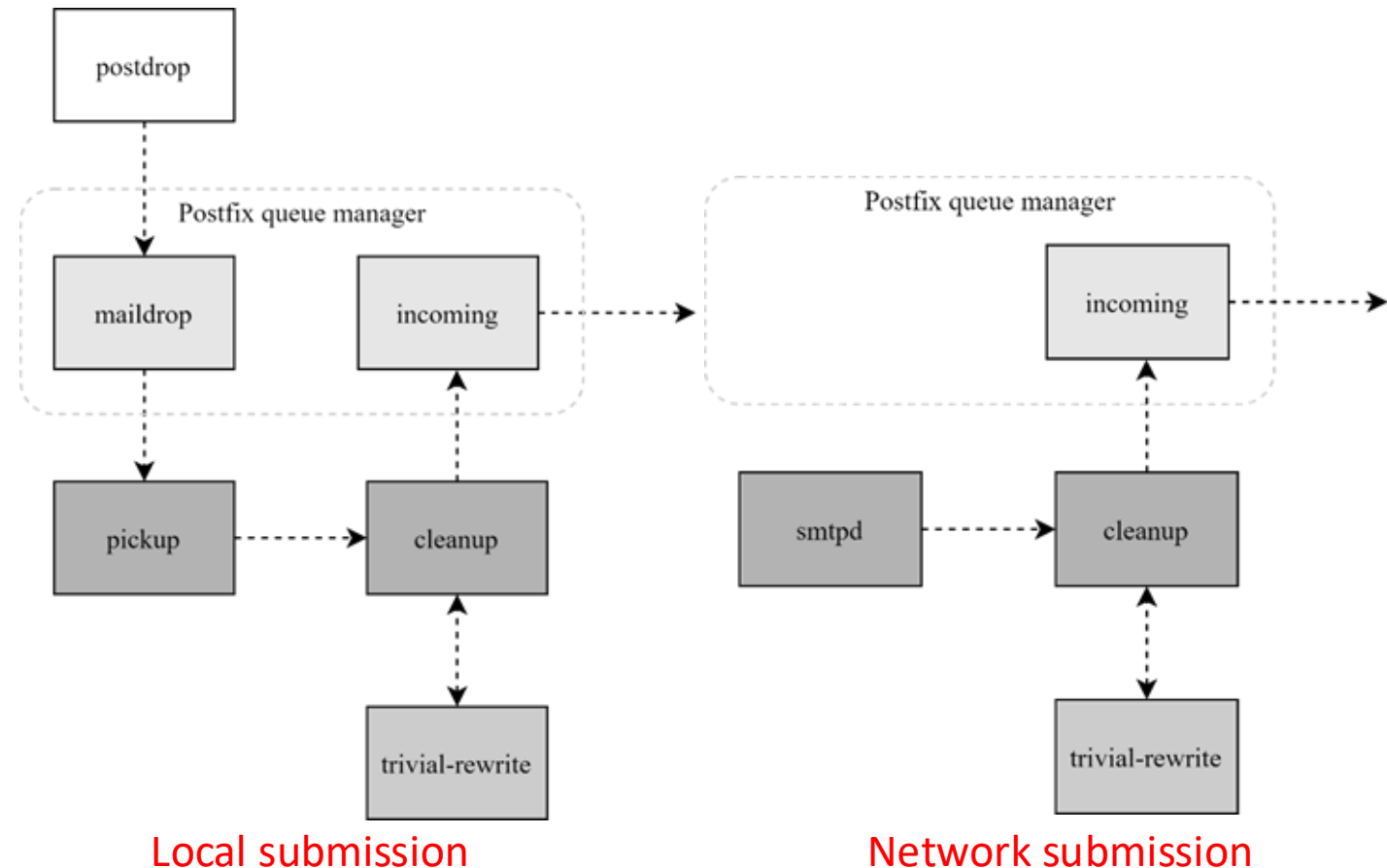
- Modular-design MTA
 - Not a monolithic system (e.g. sendmail).
 - Several individual programs => each one handles specific task
 - Most important: “**master**”
 - Reside in memory (daemon)
 - Load configuration from **master.cf** and **main.cf**
 - Invoke other processes for tasks
- Major tasks
 - Receive mail and put in **queue (/var/spool/postfix)**
 - Queue management
 - Delivery mail from queue

```
$ ls /var/spool/postfix
active      flush      private
bounce     hold       public
corrupt    incoming   saved
defer      maildrop   trace
deferred   pid
```



Postfix Architecture – Message IN

- Local submission
 - “postdrop” command
 - “maildrop” queue
 - “pickup” daemon
 - “cleanup” daemon
 - Header/address validation
 - “incoming” queue
- Network submission
 - “smtpd” daemon
- Local forwarding
 - Resubmit for such as `.forward`
 - Envelope “to” is changed
- Notification
 - Notify admin when error happens

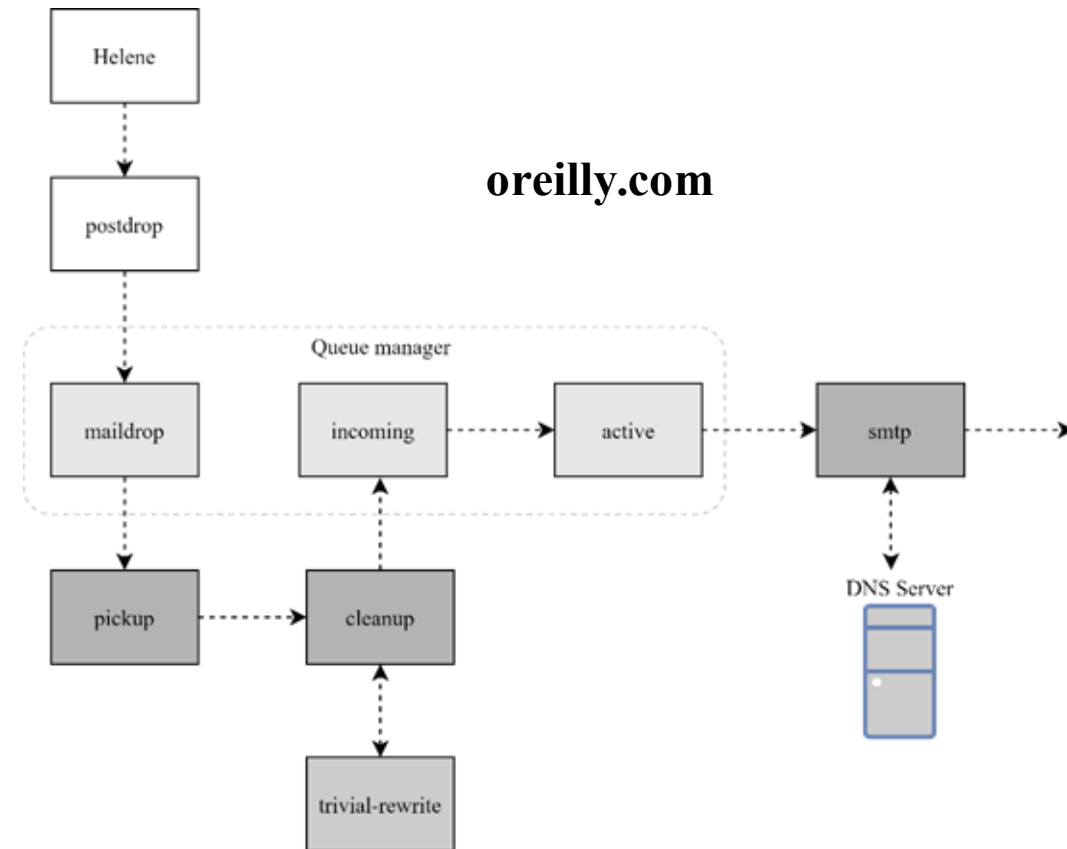


Postfix Architecture – Queue

- **incoming**
 - The **first queue** that every incoming email will stay
- **active**
 - Queue manager will move message into active queue **whenever there is enough system resources**
 - Queue manager **then invokes suitable DA** to delivery it
- **deferred**
 - Messages that **cannot be delivered** are moved here
 - These messages are **sent back** either with **bounce** or **defer** daemons
- **corrupt**
 - Used to store **damaged or unreadable message**
- **hold**
 - **Requested by admin** (**manually** or automatically)
 - Stay in queue until admin intervenes

Message Flow in Postfix (1)

- Example
 - helene@oreilly.com => frank@postfix.org
 - Phase1:
 - Compose mail using MUA
 - Call `postdrop` command to send it
 - To “maildrop” queue



Message Flow in Postfix (2)

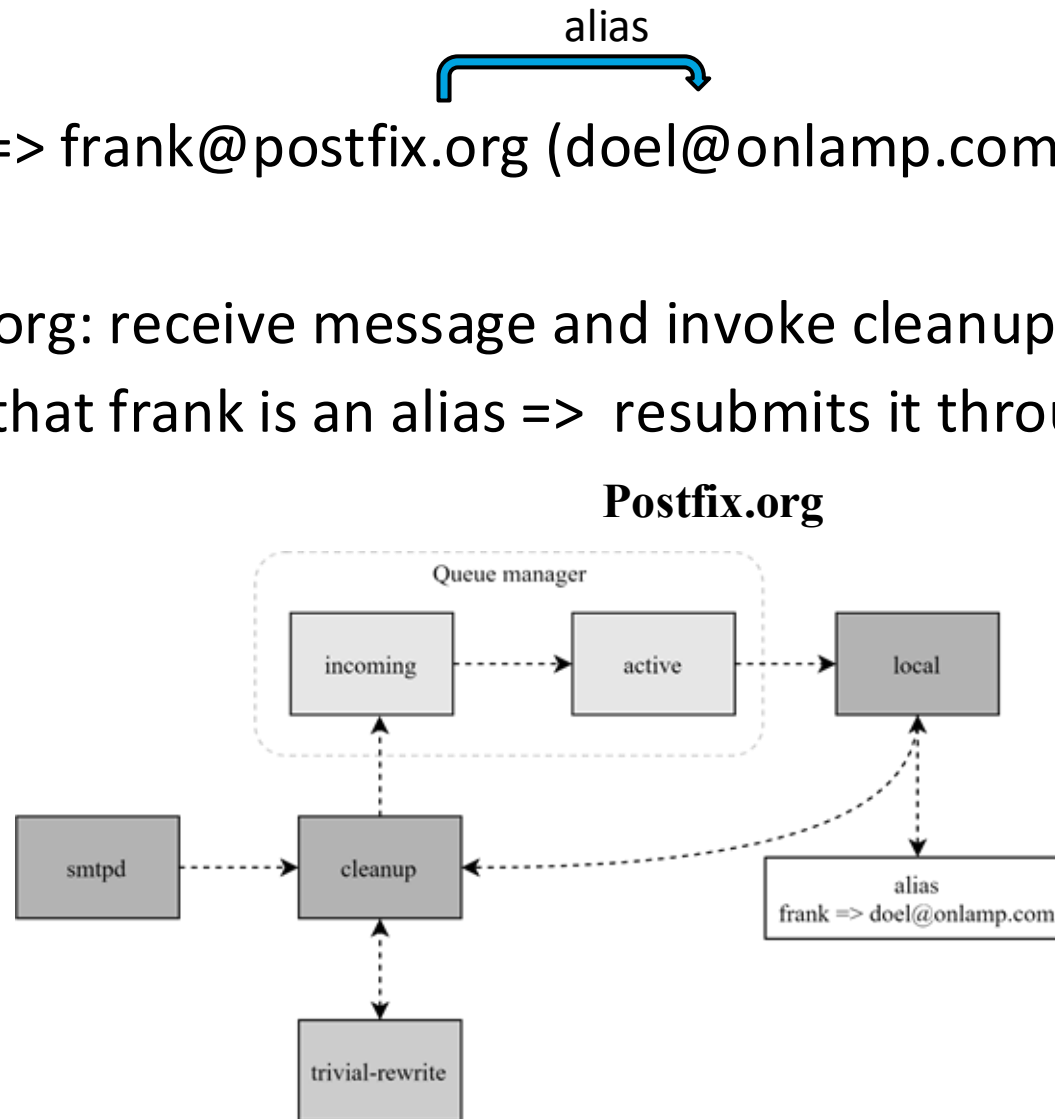
- Example

- helene@oreilly.com => frank@postfix.org (doel@onlamp.com)

- Phase2:

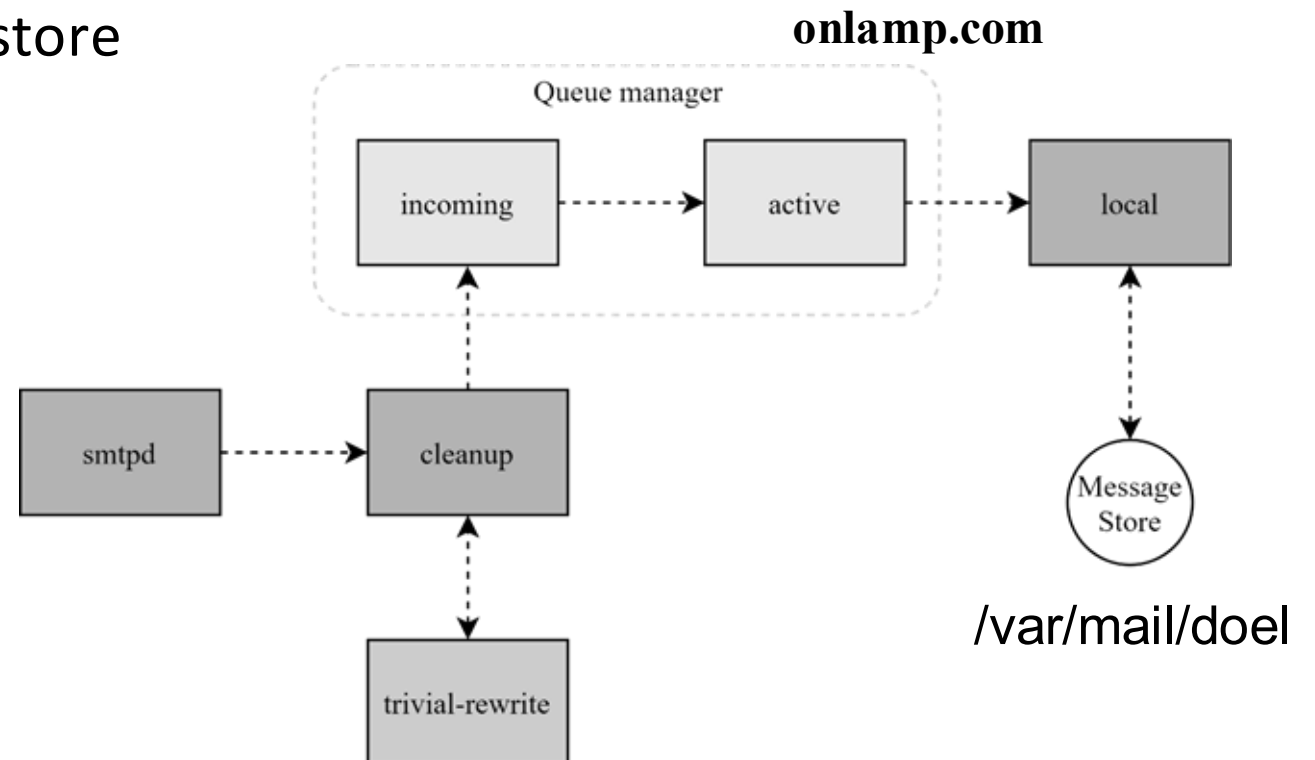
- smtpd on postfix.org: receive message and invoke cleanup

- “local” MDA find that frank is an alias => resubmits it through cleanup daemon



Message Flow in Postfix (3)

- Example
 - frank@postfix.org => doel@onlamp.com
 - Phase3:
 - smtpd on onlamp.com: receive message and invoke cleanup
 - Local delivery to message store



Message Store Format

- The **Mbox** format
 - Store messages in single file for each user
 - Each message start with "From" line and continued with message headers and body
 - Mbox format has file-locking problem (performance)
 - The **Maildir** format
 - Use structure of directories to store email messages
 - Each message is in its owned file
 - Three subdirectories - cur, new, and tmp
 - Maildir format has scalability problem
 - locate and delete mails quickly, but waste amounts of fd, inodes, space
 - Problems of quota and backup
- cur: already read
new: unread
tmp: under receiving (working dir)

Message Store Format

Source: <https://www.postfix.org/postconf.5.html>

mail_spool_directory (default: see "postconf -d" output)

The directory where [local\(8\)](#) UNIX-style mailboxes are kept. The default setting depends on the system type. Specify a name ending in / for maildir-style delivery.

- Related parameters (in main.cf)
 - mail_spool_directory = /var/mail (Mbox)
 - mail_spool_directory = /var/mail/ (Maildir)

```
tsaimh@bsd1:~ $ ls -l /var/mail/tsaimh
-rw----- 1 tsaimh tsaimh 51204482 Apr 15 09:25 /var/mail/tsaimh
tsaimh@bsd1:~ $ head -3 /var/mail/tsaimh
From tsaimh@imslab.org Tue Apr 23 14:51:46 2024
Return-Path: <tsaimh@imslab.org>
Received: from bsd1.imslab.org (localhost [127.0.0.1])
tsaimh@bsd1:~ $
```

Mailbox Format Supported by Dovecot

Name	Tag	Description
<u>obox</u>	obox	OX Dovecot Pro object storage mailbox format. (Pro only)
<u>mbox</u>	mbox	Traditional UNIX mailbox format. Users' INBOX mailboxes are commonly stored in <code>/var/spool/mail</code> or <code>/var/mail</code> directory. Single file contains multiple messages.
<u>Maildir</u>	maildir	One file contains one message. A reliable choice since files are never modified and all operations are atomic. The top-level Maildir directory contains the <code>Maildir/cur</code> , <code>Maildir/new</code> , and <code>Maildir/tmp</code> subdirectories.
<u>dbx</u>	sdbox	single-dbox , one message per file.
	mdbox	multi-dbox , multiple messages per file.
		Dovecot's own high performance mailbox format. Messages are stored in one or more files, each containing one or more messages.
<u>imapc</u>	imapc	Use remote IMAP server as mail storage.
<u>pop3c</u>	pop3c	Use remote POP3 server as mail storage.

Supported by Postfix

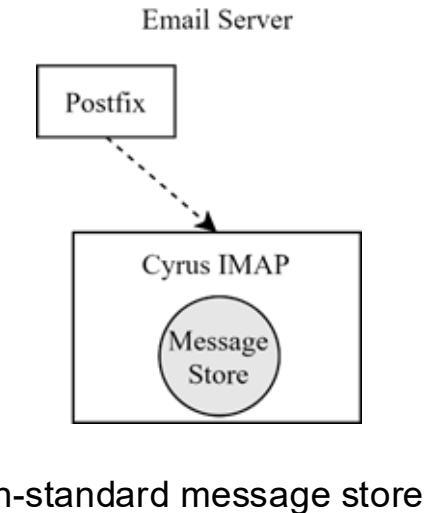
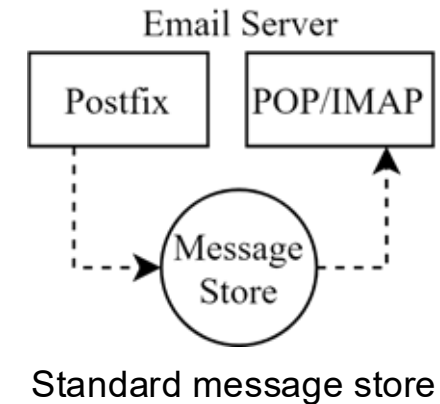
Read your mail from terminal

- To read mails, you must login via ssh
 - Built-in command to read mail: "mail"
 - Friendly command-line MUA: "mutt"
 - Pkg: mutt
 - Port: mail/mutt
- To read from remote host
 - Supports MUA like Outlook, Thunderbird, or even Gmail
 - You need MAA (supports IMAP/POP3)
 - Dovecot
 - Pkg: dovecot
 - Port: mail/dovecot

Postfix & POP3/IMAP



- POP3 vs. IMAP
 - Both are used to retrieve mail from server for remote clients
 - POP3 has to download **entire message**, while IMAP can download **headers only**
 - POP3 can download only **single mailbox**, while IMAP can let you maintain **multiple mailboxes and folders** on server
- Postfix works together with POP3/IMAP
 - Postfix and POP3/IMAP **must agree** on the type of **mailbox format** and style of locking
 - Standard message store
 - Such as **Cyrus IMAP** or **Dovecot**
 - Non-standard message store



Postfix Configuration

- Two most important configuration files
 - /usr/local/etc/postfix/main.cf – postconf(5)
 - Core configuration
 - /usr/local/etc/postfix/master.cf – master(5)
 - Which postfix service should invoke which program
- Edit main.cf
 - Using text editor
 - postconf
 - `$ postconf [-e] "myhostname=nasa.cs.nycu.edu.tw"`
 - `$ postconf -d myhostname` (print default setting)
 - `$ postconf myhostname` (print current setting)
- Reload postfix whenever there is a change
 - `$ postfix reload`

```
$ hostname  
bsd1.imslab.org  
$ postconf -d myhostname  
myhostname = bsd1.imslab.org  
$ postconf myhostname  
myhostname = mx1.imslab.org
```

Postfix Configuration – Lookup tables (1)


- Parameters that use external files to store values
 - Such as mydestination, mynetwork, relay_domains
 - Text-based table is ok, but time-consuming when table is large
- Lookup tables syntax
 - Key values
- Database format
 - `$ postconf -m`
 - List all available database format
 - In main.cf
 - `default_database_type`

```
% postconf -m
btree
cidr
environ
hash
internal
proxy
regexp
static
tcp
texthash
unix
```

```
$ postconf default_database_type
default_database_type = hash
$ postconf -h default_database_type
hash
```

http://www.postfix.org/DATABASE_README.html

Postfix Configuration – Lookup tables (2)

- Use databased-lookup table in main.cf
 - Syntax
 - parameter = type:name
 - E.g.
 - In main.cf
 - canonical_maps = hash:/usr/local/etc/postfix/canonical
 - After execute postmap
 - /usr/local/etc/postfix/canonical.db
 - postmap command
 - Generate database
 - \$ postmap hash:/usr/local/etc/postfix/canonical
 - Query
 - \$ postmap -q nycu.edu.tw hash:/usr/local/etc/postfix/canonical
- don't need to add ".db" here
- 

Postfix Configuration – Lookup tables (3)

- Regular expression tables
 - More flexible for matching keys in lookup tables
 - Sometimes you cannot list all the possibilities
 - Two regular expression libraries used in Postfix
 - POSIX extended regular expression (regexp, default)
 - Perl-Compatible regular expression (PCRE)

- Usage

- /pattern/ value
- Do some content checks (filtering)

- header_checks
- body_checks

- Design some features

- /(\S+)\.(\S+)@cs\.nycu\.edu\.tw/ \$1@cs.nycu.edu.tw

tsaimh.ABC@cs.nycu.edu.tw -> tsaimh@cs.nycu.edu.tw



Like the "+" sign used in Gmail

Postfix Configuration – Categories

- Categories
 - Server identities
 - my...
 - Mail rewriting
 - for incoming/outgoing mails
 - Access control
 - restrictions
 - Mail processing
 - filter
 - Operation details
 - ...

Postfix Configuration – MTA Identity

- myhostname
 - `myhostname = nasa.cs.nycu.edu.tw`
 - If un-specified, postfix will use `'hostname'` command
- mydestination
 - List **all the domains** that postfix **should accept for local delivery**
 - `mydestination = $myhostname, localhost.$mydomain $mydomain`
 - `mydestination = $myhostname www.$mydomain, ftp.$mydomain`
- mydomain
 - `mydomain = cs.nycu.edu.tw`
 - If un-specified, postfix use **myhostname minus the first component**
- myorigin
 - `myorigin = $mydomain` (default is `$myhostname`)

Postfix Configuration – System-wide aliases

- Using aliases in Postfix (first-matching)
 - `alias_maps = hash:/etc/aliases`
 - `alias_maps = hash:/etc/aliases, nis:mail.aliases`
 - `alias_database = hash:/etc/aliases`
- `alias_map` vs. `alias_database`
 - `alias_map`
 - Which map to use (lookup table)
 - Not all of them is controlled by Postfix
 - E.g. nis
 - `alias_database`
 - Tell "**newaliases**" which (local) database to rebuild

Postfix Configuration – System-wide aliases

- To Build alias database file
 - `$ postalias /etc/aliases`
 - Can be used on files other than `/etc/aliases`
 - `$ newaliases`
 - For `/etc/aliases` => can be changed by "alias_database"
- Alias file format (same as sendmail)
 - Value can be
 - **Email address, filename, |command, :include:**
- Alias restriction (alias, forward, include)
 - `allow_mail_to_commands = alias, forward`
 - `allow_mail_to_files = alias, forward`

Postfix Configuration – Virtual Alias Maps

- It recursively rewrites envelope recipient addresses for all local, all virtual, and all remote mail destinations.
- `virtual_alias_domains = $virtual_alias_maps` (default)
- `virtual_alias_maps = hash:/usr/local/etc/postfix/virtual`
 - | src-address | dst-address |
|------------------------------------|-----------------------------------|
| <code>tsaimh@cs.nycu.edu.tw</code> | <code>@nasa.cs.nycu.edu.tw</code> |
| <code>tsaimh</code> | <code>alice@gmail.com</code> |
| <code>@cs.nycu.edu.tw</code> | <code>@cs.nycu.edu.tw</code> |
- Applying regular expression
 - `virtual_alias_maps = pcre:/usr/local/etc/postfix/virtual`
 - `/^root(\..+)?@(t)?(cs|np)?bsd\d*\.\cs\.\nycu\.\edu\.\tw$/` `bsdta@cs.nycu.edu.tw`
 - `/^root(\..+)?@(t)?(cs|np)?linux\d*\.\cs\.\nycu\.\edu\.\tw$/` `linuxta@cs.nycu.edu.tw`
 - `/^root(\..+)?@(t)?csmail\w*\d*\.\cs\.\nycu\.\edu\.\tw$/` `mailta@cs.nycu.edu.tw`

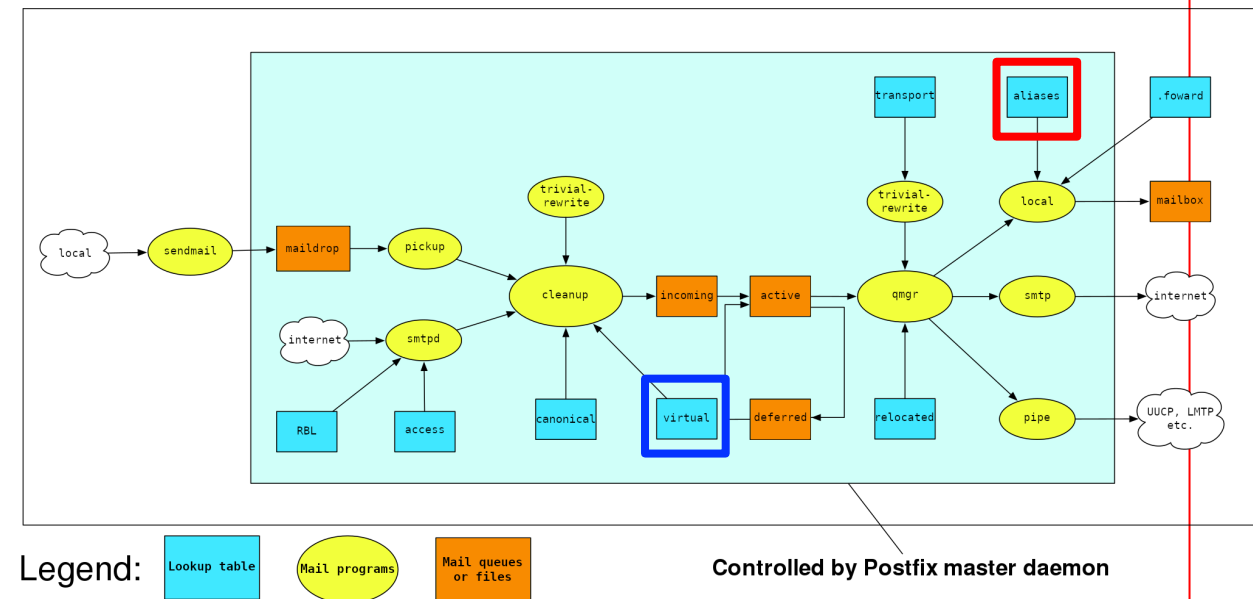
Postfix Configuration – Virtual Alias Maps vs. Alias Map

● **alias_map**

- Used by [local\(8\)](#) delivery
- **Key must be local recipients**
- Value can be **email/file/command/...**

● **virtual_alias_maps**

- Used by [virtual\(5\)](#) delivery
- Higher priority than `alias_map`
- **Key can be**
 - **user@domain**
 - **user**
 - **@domain**
- Value must be **valid email addresses or local recipients**



Postfix Configuration – Relay Control (1)

- Open relay

- A mail server that permit anyone to relay mails
 - Either originates or ends with a user from its domain
 - Spam
- By default, postfix is not an open relay

- A mail server should

- Relay mail for **trusted user**
 - Such as `tsaimh@smtp.cs.nycu.edu.tw`
- Relay mail for **trusted domain**
 - E.g. `smtp.cs.nycu.edu.tw` trusts `cs.nycu.edu.tw`

Postfix Configuration – Relay Control (2)

- Restricting relay access by **mynetworks_style**
 - `mynetworks_style = host`
 - Allow relaying for only local machine (the default setting)
 - `mynetworks_style = subnet`
 - Allow relaying from other hosts in the same **subnet**, configured in this machine
 - `mynetworks_style = class`
 - Any host in the same class A, B or C
 - **Usually we don't use this** - your server may trust the whole subnet from your ISP

Postfix Configuration – Relay Control (3)

- Restricting relay access by **mynetworks** (**override mynetworks_style**)
 - List individual IP or subnets in network/netmask notation
 - E.g. in [/usr/local/etc/postfix/mynetworks](#)
 - 127.0.0.0/8
 - 140.113.0.0/16
 - 10.113.0.0/16
- Relay depends on the type of your mail server
 - [smtp.cs.nycu.edu.tw](#) will be **different** from [csmx1.cs.nycu.edu.tw](#)
 - Outgoing: usually accepts submission from local domain
 - Incoming: may relay mails for trusted domains

Postfix Configuration – Rewriting address (1)

- For unqualified address
 - To append "myorigin" to local name
 - tsaimh => tsaimh@nasa.cs.nycu.edu.tw
 - `append_at_myorigin = yes`
 - To append "mydomain" to address that contain only host.
 - tsaimh@nasa=> tsaimh@nasa.cs.nycu.edu.tw
 - `append_dot_mydomain = yes`

Postfix Configuration – Rewriting address (2)

- Masquerading hostname
 - Hide the names of internal hosts to make all addresses appear as if they come from the same mail server
 - It is often used in [out-going mail gateway](#)
 - `masquerade_domains = cs.nycu.edu.tw`
 - `tsaimh@subdomain.cs.nycu.edu.tw => tsaimh@cs.nycu.edu.tw`
 - `masquerade_domains = !chairman.cs.nycu.edu.tw cs.nycu.edu.tw`
 - `masquerade_exceptions = admin, root`
 - Rewrite to all envelope and header address **excepts** [envelope recipient](#) address (the default)
 - `masquerade_class = envelope_sender, header_sender, header_recipient`
 - This allows incoming messages can be filtered based on their recipient address

Postfix Configuration – Rewriting address (3)

- Canonical address – canonical(5)
 - Rewrite both **header** and **envelope** recursively invoked by **cleanup** daemon
 - In main.cf
 - canonical_maps = hash:/usr/local/etc/postfix/canonical
 - canonical_classes = envelope_sender, envelope_recipient, header_sender, header_recipient
 - In canonical

```
/^(.*)@(t)?(cs)?(bsd|linux|sun)d*\.\cs\.\nycu\.\edu\.\tw$/      $1@cs.nycu.edu.tw
```
 - Similar configurations
 - sender_canonical_maps 、 sender_canonical_classes
 - recipient_canonical_maps 、 recipient_canonical_classes

Postfix Configuration – Rewriting address (4)

- Relocated users

- Used to inform sender that the recipient is moved
 - "user has moved to *new_location*" bounce messages
- In main.cf
 - **relocated_maps** = hash:/usr/local/etc/postfix/relocated
- In relocated

andy@nasa.cs.nycu.edu.tw	andyliu@abc.com
tsaimh	EC117, NYCU, Hsinchu, ROC
@nabsd.cs.nycu.edu.tw	zfs.cs.nycu.edu.tw

Value can be anything: phone number, street address, ...

- Unknown users

- Not local user and not found in maps
- **Default action: reject**

Postfix Configuration – master.cf (1)

- /usr/local/etc/postfix/master.cf (**master(5)**)
 - Define services that **master** daemon can invoke
 - Each row defines a service and
 - Each column contains a specific configuration option

```
# =====  
# service type  private unpriv  chroot  wakeup  maxproc  command + args  
#              (yes)   (yes)   (yes)   (never) (100)  
# =====  
smtp          inet    n        -       n       -       -       smtpd  
pickup        unix    n        -       n       60      1       pickup  
cleanup        unix    n        -       n       -       0       cleanup  
rewrite        unix    -        -       n       -       -       trivial-rewrite  
smtp          unix    -        -       n       -       -       smtp  
local         unix    -        n       n       -       -       local  
virtual        unix    -        n       n       -       -       virtual  
relay         unix    -        -       n       -       -       smtp  
              -o smtp_fallback_relay=  
lmtmp         unix    -        -       n       -       -       lmtmp  
maildrop      unix    -        n       n       -       -       pipe  
              flags=DRhu user=vmail argv=/usr/local/bin/maildrop -d ${recipient}
```

Postfix Configuration – master.cf (2)

- Configuration options
 - Service name
 - Service type
 - inet, unix, fifo (obsolete), or pass
 - Private
 - Access to this component is restricted to the Postfix system
 - "inet" type cannot be private
 - Unprivileged
 - Run with the least amount of privilege required
 - y will run with the account defined in "mail_owner"
 - n will run with root privilege
 - local, pipe, spawn, and virtual


Postfix Configuration – master.cf (3)

- Configuration options
 - Chroot
 - chroot location is defined in "queue_directory"
 - Wake up time
 - Automatically wake up the service after the number of seconds
 - Process limit
 - Number of processes that can be executed simultaneously
 - Default count is defined in "default_process_limit"
 - command + args
 - Default path is defined in "daemon_directory"
 - /usr/libexec/postfix

Postfix Architecture – Message OUT

- Local delivery
- Relay to the destinations
- Other delivery agent (MDA)
 - Specify in `/usr/local/etc/postfix/master.cf`
 - How a client program connects to a service and what daemon program runs when a service is requested
 - lmtpl
 - Local Mail Transfer Protocol (Limited SMTP)
 - No queue
 - One recipient at once
 - Used to deliver to mail systems **on the same network** or even the same host
 - pipe
 - Used to deliver message **to external program**

Mail Relaying – Transport Maps (1)

- Transport maps – transport(5)
 - It **override default** transport method to deliver messages
 - In main.cf
 - `transport_maps = hash:/usr/local/etc/postfix/transport`
 - In transport file  **"Service" defined in master.cf**
 - `domain_or_address transport:nexthop`

csie.nycu.edu.tw

smtp:[mailgate.csie.nycu.edu.tw]

cs.nycu.edu.tw

smtp:[csmailgate.cs.nycu.edu.tw]

cis.nycu.edu.tw

smtp:[mail.cis.nycu.edu.tw]

example.com

smtp:[192.168.23.56]:20025

orilynet.com

smtp

ora.com

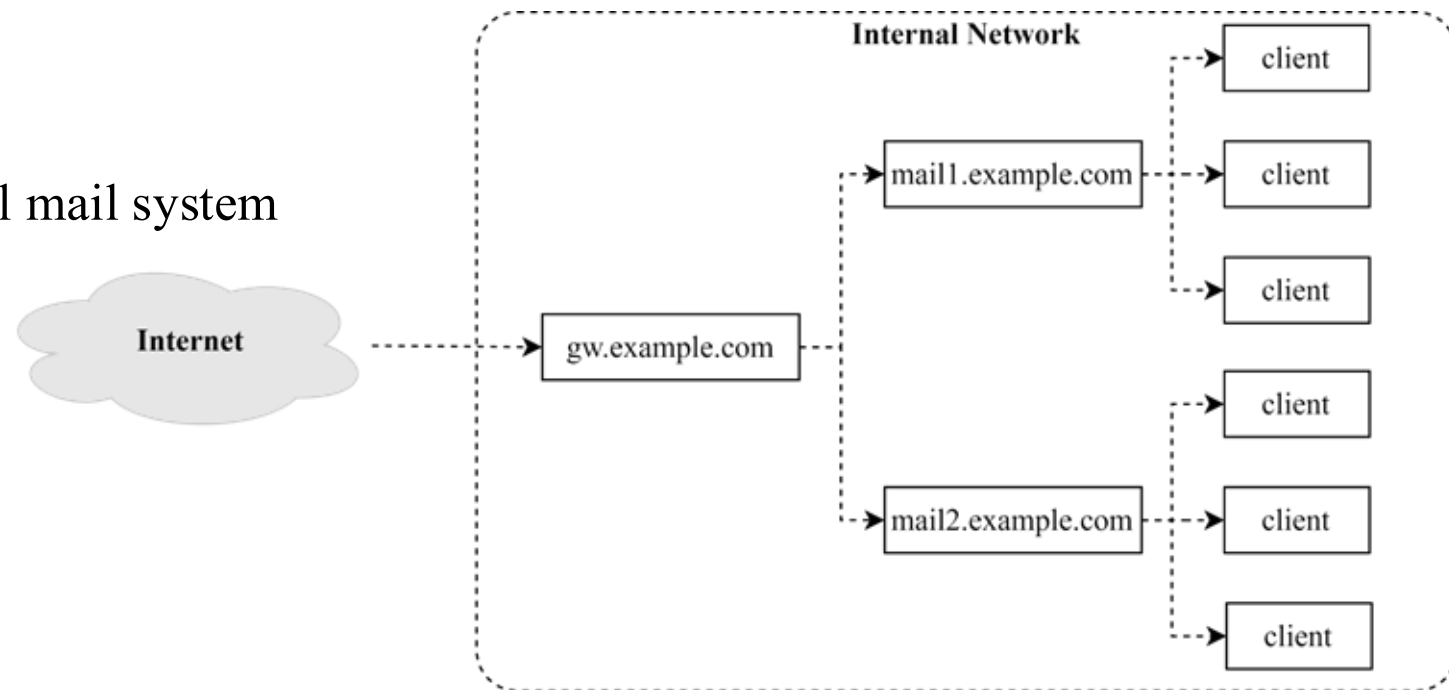
maildrop

kdent@ora.com

error:no mail accepted for kdent

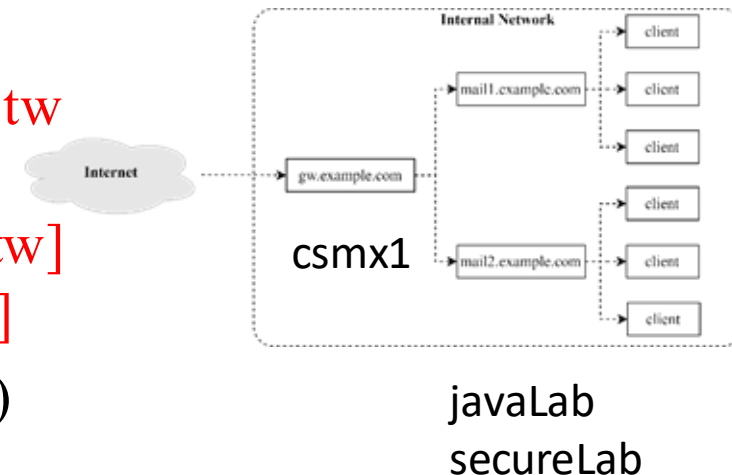
Mail Relaying – Inbound Mail Gateway (1)

- Inbound Mail Gateway (IMG, MX)
 - Accept all mail for a network from the Internet and relays it to internal mail systems
 - E.g.
 - gw.example.com is a IMG
 - With MX records
 - mail1.example.com is internal mail system
 - Serves internal subnet



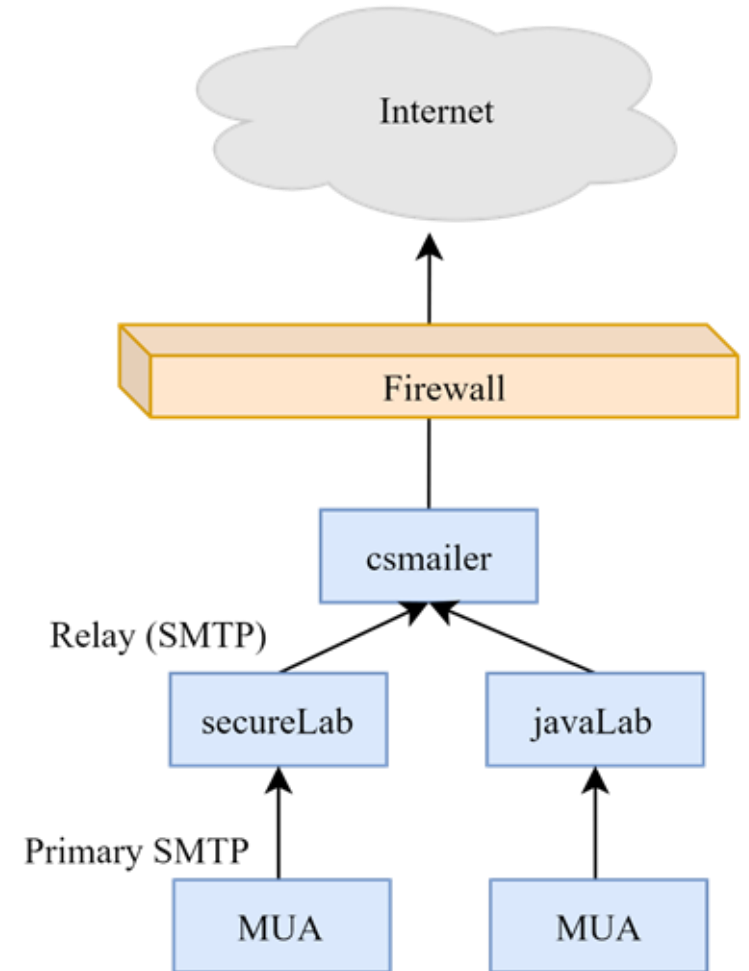
Mail Relaying – Inbound Mail Gateway (2)

- To be IMG, suppose
 - You are administrator for cs.nycu.edu.tw
 - Hostname is `csmx1.cs.nycu.edu.tw`
 - You have to be the IMG for `secureLab.cs.nycu.edu.tw` and `javaLab.cs.nycu.edu.tw`
 - Firewall only allow outsource connect to IMG port 25
- 1. The **MX record** for `secureLab.cs.nycu.edu.tw` and `javaLab.cs.nycu.edu.tw` should point to `csmx1.cs.nycu.edu.tw`
- 2. In `csmx1.cs.nycu.edu.tw`,
`relay_domains = secureLab.cs.nycu.edu.tw javaLab.cs.nycu.edu.tw`
`transport_maps = hash:/usr/local/etc/postfix/transport`
`secureLab.cs.nycu.edu.tw relay:[secureLab.cs.nycu.edu.tw]`
`javaLab.cs.nycu.edu.tw relay:[javaLab.cs.nycu.edu.tw]`
- 3. In `secureLab.cs.nycu.edu.tw` (and so do `javaLab.cs.nycu.edu.tw`)
`mydestination = secureLab.cs.nycu.edu.tw`



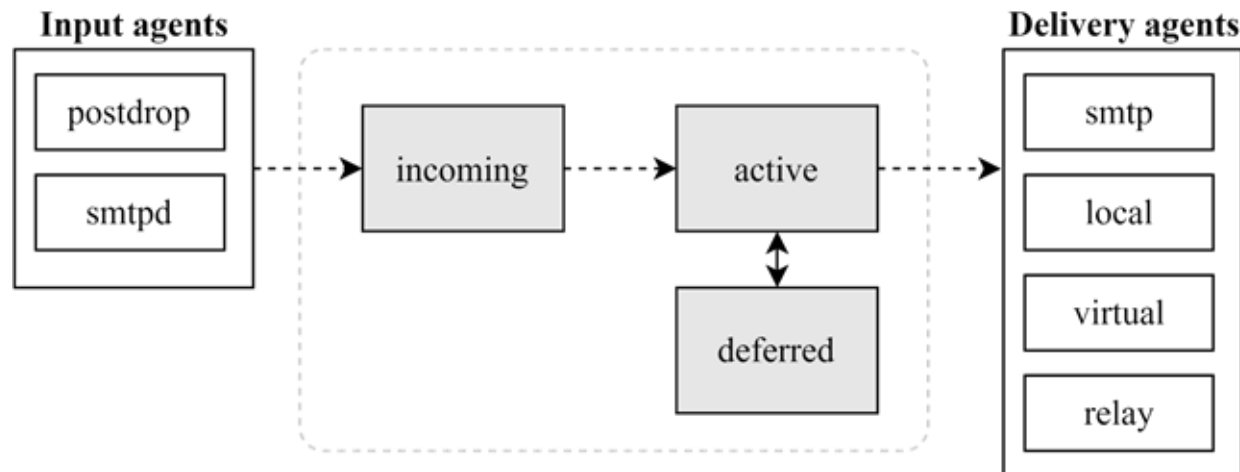
Mail Relaying – Outbound Mail Gateway

- Outbound Mail Gateway
 - Accept mails from inside network and relay them to Internet hosts
- To be OMG, suppose
 - You are administrator for cs.nycu.edu.tw
 - Hostname is `csmailer.cs.nycu.edu.tw`
 - You have to be the **OMG for secureLab.cs.nycu.edu.tw** and **javaLab.cs.nycu.edu.tw**
- 1. In `main.cf` of `csmailer.cs.nycu.edu.tw`
`mynetworks = hash:/usr/local/etc/postfix/mynetworks`
- 2. **All students in secureLab/javaLab** will configure their MUA to use `secureLab/javaLab.cs.nycu.edu.tw` to be the **SMTP server**
- 3. In `main.cf` of `secureLab/javaLab.cs.nycu.edu.tw`,
`relayhost = [csmailer.cs.nycu.edu.tw]`



Queue Management

- The queue manage daemon
 - “qmgr” daemon
 - Unique queue ID
 - Queue directories (/var/spool/postfix/*)
 - active, bounce, corrupt, deferred, hold
- Message movement between queues
 - Takes messages alternatively between **incoming and deferred to active** queue



Queue Management – Queue Scheduling

- Double delay in deferred messages
 - Between
 - `minimal_backoff_time = 300s`
 - `maximal_backoff_time = 4000s`
 - Periodically scan deferred queue for reborn messages
 - `queue_run_delay = 300s`
- Deferred => bounce
 - `maximal_queue_lifetime = 5d`

Queue Management – Message Delivery

- Controlling outgoing messages
 - Avoid overwhelming the destination when there are lots of messages to it
 - Concurrent delivery succeed => increase concurrency between:
 - `initial_destination_concurrency = 5`
 - `default_destination_concurrency_limit = 20`
 - Under control by
 - `maxproc` in `/usr/local/etc/postfix/master.cf`
 - Customization for different transport mailers:
 - `smtp_destination_concurrency_limit = 25` **for external delivery**
 - `local_destination_concurrency_limit = 10` **for local recipients**
 - Control how many recipients for a single outgoing message
 - `default_destination_recipient_limit = 50`
 - Customization for transport mailers:
 - `smtp_destination_recipient_limit = 100`

Queue Management – Error Notification

- Sending error messages to administrator
 - Error classes to be generated and **sent to administrator**
 - notify_classes = resource, software
 - Possible error classes

Error Class	Description	Noticed Recipient (all default to postmaster)
bounce	Send headers of bounced mails	bounce_notice_recipient
2bounce	Send undeliverable bounced mails	2bounce_notice_recipient
delay	Send headers of delayed mails	delay_notice_recipient
policy	Send transcript when mail is reject due to anti-spam restrictions	error_notice_recipient
protocol	Send transcript that has SMTP error	error_notice_recipient
resource	Send notice because of resource problem	error_notice_recipient
software	Send notice because of software problem	error_notice_recipient

Queue Management – Queue Tools (2)

- [postqueue\(1\)](#)

- `postqueue -p` (or “`mailq`”)
 - Show the queued mails (no **mail content**)
- `postqueue -f`
 - Attempt to **flush(deliver)** all queued mail
- `postqueue -s`
[cs.nycu.edu.tw](#)
 - Schedule **immediate delivery** of all mail queued **for site**

- [postcat\(1\)](#)

- **Display the contents** of a queue file

```
nasa [/home/tsaimh] -tsaimh- mailq
-Queue ID- --Size-- ----Arrival Time---- -Sender/Recipient-----
3314234284A      602 Sat May 19 04:16:20  root@nasa.cs.nycu.edu.tw
      (connect to csmx1.cs.nycu.edu.tw[140.113.235.104]:25: Operation
      tsaimh@cs.nycu.edu.tw
```

```
nasa [/home/tsaimh] -tsaimh- sudo postcat -q 3314234284A
*** ENVELOPE RECORDS deferred/3/3314234284A ***
message_size:                602                214                1
message_arrival_time: Sat May 19 04:16:20 2012
create_time: Sat May 19 04:16:20 2012
sender: root@nasa.cs.nycu.edu.tw
named_attribute: rewrite_context=local
original_recipient: root
recipient: tsaimh@cs.nycu.edu.tw
*** MESSAGE CONTENTS deferred/3/3314234284A ***
Received: by nasa.cs.nycu.edu.tw (Postfix)
      id 3314234284A; Sat, 19 May 2012 04:16:20 +0800 (CST)
Delivered-To: root@nasa.cs.nycu.edu.tw
Received: by nasa.cs.nycu.edu.tw (Postfix, from userid 0)
      id 2CB713427A5; Sat, 19 May 2012 04:16:20 +0800 (CST)
To: root@nasa.cs.nycu.edu.tw
Subject: nasa.cs.nycu.edu.tw weekly run output
Message-Id: <20120518201620.2CB713427A5@nasa.cs.nycu.edu.tw>
Date: Sat, 19 May 2012 04:16:20 +0800 (CST)
From: root@nasa.cs.nycu.edu.tw (NASA Root)
```

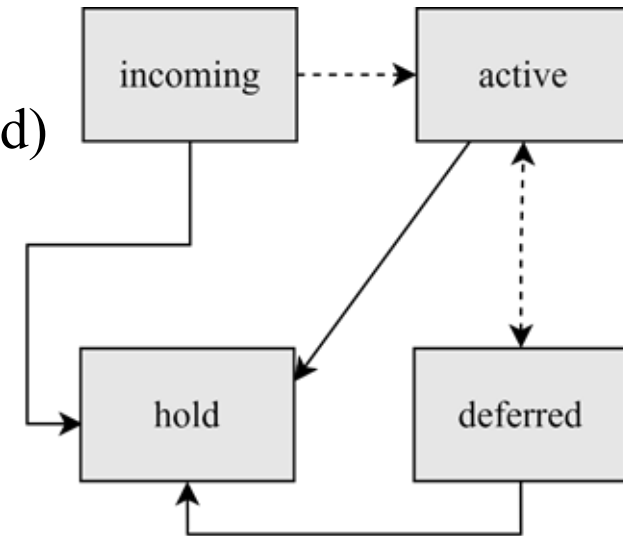
```
Rebuilding locate database:
```

```
...
```

Queue Management – Queue Tools (1)

- [postsuper\(1\)](#)

- **Delete** queued messages
 - `postsuper -d E757A3428C6` (from incoming, active, deferred, hold)
 - `postsuper -d ALL`
- Put messages "**on hold**" so that no attempt is made to deliver it
 - `postsuper -h E757A3428C6` (from incoming, active, deferred)
- Release messages in **hold** queue (**into deferred queue**)
 - `postsuper -H ALL`
- Requeue messages **into maildrop queue** (maildrop => pickup => cleanup => incoming)
 - `postsuper -r E757A3428C6`
 - `postsuper -r ALL`



Multiple Domains

- Use single system to host many domains
 - E.g.
 - We use csmailgate.cs.nycu.edu.tw to host both **cs.nycu.edu.tw** and **csie.nycu.edu.tw**
 - Purpose
 - Final delivery on the machine
 - Forwarding to destination elsewhere (mail gateway)
- Important considerations
 - Does the same user id with different domain should go to the same mailbox or different mailbox?
 - YES (shared domain)
 - NO (separate domain)
 - Does every user require a system account in /etc/passwd ?
 - YES (system account)
 - NO (virtual account)

Multiple Domains – Shared Domain with System Account

- Situation
 - Accept mails for both [canonical](#) and [virtual domains](#)
 - Same mailbox for the same user id (tsaimh@ => /var/mail/tsaimh)
- Procedure
 - Setup MX records for both domains
 - Modify "mydomain" to canonical domain
 - Modify "mydestination" parameter to let mails to virtual domain can be local delivered
 - E.g.
 - [mydomain = cs.nycu.edu.tw](#)
 - [mydestination = \\$myhostname, \\$mydomain, csie.nycu.edu.tw](#)
 - ※ In this way, mail to both [tsaimh@cs.nycu.edu.tw](#) and [tsaimh@csie.nycu.edu.tw](#) will go to `csmailgate:/var/mail/tsaimh`
- Limitation
 - Can not separate [tsaimh@cs.nycu.edu.tw](#) from [tsaimh@csie.nycu.edu.tw](#)

Multiple Domains – Separate Domains with System Accounts

- Situation

- Accept mails for both canonical and virtual domains
- Mailboxes are not necessarily the same for the same user id

- Procedure

- Modify "mydomain" to canonical domain
- Modify "`virtual_alias_domains`" to accept mails to virtual domains
- Create "`virtual_alias_maps`" map
- E.g.
 - mydomain = cs.nycu.edu.tw
 - `virtual_alias_domains` = abc.com.tw, xyz.com.tw
 - `virtual_alias_maps` = hash:/usr/local/etc/postfix/virtual ←

CEO@abc.com.tw	andy
@xyz.com.tw	jack

- Limitation

- Need to maintain system accounts for virtual domain users

Multiple Domains – Separate Domains with Virtual Accounts (1)

- Useful when users in virtual domains:
 - No need to login to system
 - Only retrieve mail through POP/IMAP server
- Procedure
 - Modify "virtual_mailbox_domains" to let postfix know what mails it should accept
 - Modify "virtual_mailbox_base" and create related directory to put mails
 - Create "virtual_mailbox_maps" map
 - E.g.
 - `virtual_mailbox_domain = abc.com.tw, xyz.com.tw`
 - `virtual_mailbox_base = /var/vmail`
 - Create /var/vmail/abc-domain and /var/vmail/xyz-domain
 - `virtual_mailbox_maps = hash:/usr/local/etc/postfix/vmailbox`
 - In /usr/local/etc/postfix/vmailbox
 - `CEO@abc.com.tw` abc-domain/CEO (Mailbox format)
 - `CEO@xyz.com.tw` xyz-domain/CEO/ (Maildir format)

Multiple Domains – Separate Domains with Virtual Accounts (2)

- Ownerships of virtual mailboxes
 - Simplest way:
 - Same owner of POP/IMAP Servers
 - Flexibility in postfix
 - virtual_uid_maps and virtual_gid_maps
 - E.g.
 - virtual_uid_maps = static:1003
 - virtual_gid_maps = static:105

 - virtual_uid_maps = hash:/usr/local/etc/postfix/virtual_uids
 - virtual_uid_maps = hash:/usr/local/etc/postfix/virtual_uids static:1003
 - In /usr/local/etc/postfix/virtual_uids
 - CEO@abc.com.tw 1004
 - CEO@xyz.com.tw 1008



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Step by Step Examples

Let's learn from examples

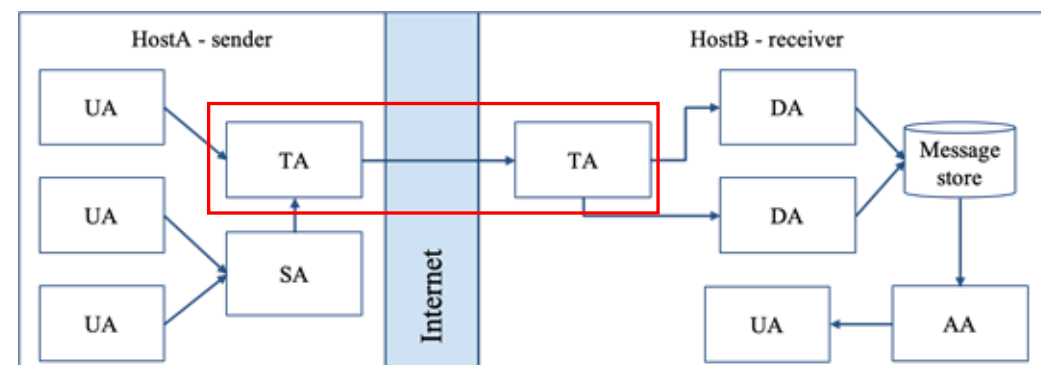
Step by Step Examples

- Build a Basic MTA
 - Send test mails to verify your MTA
 - Check whether your mail is sent or not
- MTA Authentication
- MTA Encryption
- MAA for POP3 and IMAP

- Note
 - In this example, we assume you have public IP/domain

Build a Basic MTA

Can send mails to other domain



Build a basic MTA(1)

- Can send mails to other domain
- Install Postfix
 - Pkg: postfix
 - Port: mail/postfix
- After installation
 - Disable "sendmail" program
 - service sendmail stop
 - In /etc/rc.conf
 - In /etc/periodic.conf (create if not exists)

```
sendmail_enable="NONE"
```

```
daily_clean_hoststat_enable="NO"  
daily_status_mail_rejects_enable="NO"  
daily_status_include_submit_mailq="NO"  
daily_submit_queuerun="NO"
```

Build a basic MTA(2)

- Replace sendmail by Postfix modified version
 - Edit /etc/mail/mailer.conf

```
Sendmail    /usr/local/sbin/sendmail
send-mail   /usr/local/sbin/sendmail
Mailq       /usr/local/sbin/sendmail
newaliases  /usr/local/sbin/sendmail
```

In FreeBSD:

Original sendmail: **/usr/sbin/sendmail**

Postfix version: **/usr/local/sbin/sendmail**

Build a basic MTA(3)

- After installation
 - Enable postfix
 - Edit /etc/rc.conf
 - `postfix_enable="YES"`
 - service postfix start
- Set up DNS records
 - Some domains will reject mails from hosts without DNS record
 - Suppose the hostname is "mx1.imslab.org"
 - Set up these records
 - (A record) mx1.imslab.org
 - ~~(A record) imslab.org~~
 - (MX record) imslab.org
 - Points to "mx1.imslab.org"

Build a basic MTA(4)

- Set up MTA identity
 - In main.cf

```
myhostname = mx1.imslab.org
mydomain = imslab.org
myorigin = $myhostname
mydestination = $myhostname, localhost. $mydomain,
                localhost, $mydomain
```

- Reload or restart postfix to apply changes
 - \$ postfix reload

Send test mails to verify your MTA(1)

- "telnet" or "mail" command

```
From tsaimh@nycu.edu.tw Thu May 2 00:21:39 2024
Return-Path: <tsaimh@nycu.edu.tw>
X-Original-To: tsaimh@imslab.org
Delivered-To: tsaimh@imslab.org
Received: from bsd1.imslab.org (localhost
[IPv6:::1])
    by mx1.imslab.org (Postfix) with ESMTP id
C3ABC1837B
    for <tsaimh@imslab.org>; Thu, 02 May 2024
00:21:16 +0800 (CST)
Subject: This is the subject
Message-Id:
<20240501162121.C3ABC1837B@mx1.imslab.org>
Date: Thu, 02 May 2024 00:21:16 +0800 (CST)
From: tsaimh@nycu.edu.tw

This is the body
```

```
> telnet localhost 25
Trying ::1...
Connected to localhost.
Escape character is '^]'.
220 mx1.imslab.org ESMTP Postfix
ehlo bsd1.imslab.org
250-mx1.imslab.org
250-PIPELINING
250-SIZE 10240000
250-VRFY
250-ETRN
250-ENHANCEDSTATUSCODES
250-8BITMIME
250-DSN
250-SMTPUTF8
250 CHUNKING
mail from: tsaimh@nycu.edu.tw
250 2.1.0 Ok
rcpt to: tsaimh@imslab.org
250 2.1.5 Ok
data
354 End data with <CR><LF>.<CR><LF>
Subject: This is the subject

This is the body
.
250 2.0.0 Ok: queued as C3ABC1837B
```

telnet

Send test mails to verify your MTA(2)

- The "mail" command

mail

```
$ mail -s "test from imslab" tsaimh@nycu.edu.tw  
you have mail  
This is a test mail from bsd1.imslab.org  
regards,  
IMSLab  
EOT          (Press Ctrl+D)
```

Gmail: tsaimh@nycu.edu.tw

test from imslab 外部 收件匣 ×



Meng-Hsun Tsai <tsaimh@imslab.org>

寄給我 ▾



翻譯成中文 (繁體)



This is a test mail from bsd1.imslab.org
regards,
IMSLab

Send test mails to verify your MTA(3)

- Mail source text of the previous example

Delivered-To: tsaimh@nycu.edu.tw

< ... omitted ... >

Authentication-Results: mx.google.com; spf=neutral (google.com: 140.116.245.245 is neither permitted nor denied by best guess record for domain of tsaimh@imslab.org)
smtp.mailfrom=tsaimh@imslab.org

Received: by mx1.imslab.org (Postfix, from userid 1001) id E65C81837D; Thu, 02 May 2024 00:41:10 +0800 (CST)

To: tsaimh@nycu.edu.tw

Subject: test from imslab

Message-Id: <20240501164110.E65C81837D@mx1.imslab.org> Date: Thu, 02 May 2024 00:41:10 +0800 (CST)

From: Meng-Hsun Tsai <tsaimh@imslab.org>

This is a test mail from bsd1.imslab.org

regards,
IMSLab

Check whether your mail is sent or not (1)

- Sometimes, we do not receive mails immediately
 - There may be some errors when your MTA sending mails to other domain
- Mails will stay in queues
 - Contain information about each mail
- Tools to management mail queues
 - postqueue
 - postsuper

Check whether your mail is sent or not (2)

- Example for rejected mails (send mails to @cs.nycu.edu.tw)

```
-Queue ID- --Size-- ----Arrival Time---- -Sender/Recipient-----  
3C868150      377 Sun Mar  6 18:23:11  tsaimh@nasa.tsaimh.nycucs.net  
(host csmx3.cs.nycu.edu.tw[140.113.235.119] said: 450 4.1.8  
<tsaimh@nasa.tsaimh.nycucs.net>: Sender address rejected: Domain not found  
(in reply to RCPT TO command) tsaimh@cs.nycu.edu.tw  
  
-- 0 Kbytes in 1 Request.
```

- Problem
 - The destination MX cannot verify the **domain of sender host**
- Reason
 - You may forget to set up correct DNS record
- This mail will **NOT** be delivered until you set up your DNS record

Check whether your mail is sent or not (3)

- Example for deferred mails

```
-Queue ID- --Size-- ----Arrival Time---- -Sender/Recipient-----  
3C868150      377 Sun Mar  6 18:23:11  tsaimh@nasa.tsaimh.nycucs.net  
(host csmx1.cs.nycu.edu.tw[140.113.235.104] said: 450 4.2.0  
<tsaimh@cs.nycu.edu.tw>: Recipient address rejected: Greylisted,  
  see http://postgrey.schweikert.ch/help/cs.nycu.edu.tw.html  
  (in reply to RCPT TO command))      tsaimh@cs.nycu.edu.tw  
  
-- 0 Kbytes in 1 Request.
```

- Problem
 - The mail is deferred for a short time
- Reason
 - Destination host wants to examine our server is a spamming host or not
- The mail will be delivered after a short time
 - Generally within 30 minutes



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MTA Authentication

We don't want unauthorized user to access our MTA

MTA authentication(1)

- In previous example, only localhost can send mail to other domain
- If you try telnet on other host, when you try to send mails to other domain, you will get:

```
> telnet dem01.nasa.tsaimh.nycucs.net 25
Trying 140.113.168.238...
Connected to dem01.nasa.tsaimh.nycucs.net.
Escape character is '^]'.
220 dem01.nasa.tsaimh.nycucs.net ESMTP Postfix
MAIL FROM: tsaimh@dem01.nasa.tsaimh.nycucs.net
250 2.1.0 Ok
RCPT TO: tsaimh@gmail.com
454 4.7.1 <tsaimh@gmail.com>: Relay access denied
```

- That is because you have following lines (default) in main.cf

```
mynetworks_style = host
```

- So Postfix only trust clients from localhost

MTA authentication(2)

- How to let SMTP clients outside from trust networks get the same privileges as trusted hosts?
 - Can send mails to other domain, not only **\$mydestination**
 - We need authentication (account and password)
- SASL Authentication
 - Simple Authentication and Security Layer
 - [RFC 2554](#), [RFC 4954](#)
- To configure SASL for Postfix, we need another daemon
 - Dovecot SASL (we use it in our example)
 - Cyrus SASL
- References
 - <http://wiki2.dovecot.org/>
 - http://www.postfix.org/SASL_README.html

MTA authentication(3) - Dovecot SASL

- Installation
 - Pkg: dovecot
 - Port: mail/dovecot
- Enable Dovecot SASL daemon
 - In /etc/rc.conf

```
dovecot_enable="YES"
```
 - Copy configuration files

```
cp -R /usr/local/etc/dovecot/example-config/* \  
/usr/local/etc/dovecot
```
 - Create SSL keys for Dovecot (self-signed or use Let's Encrypt)
 - Change path for SSL files in `/usr/local/etc/dovecot/conf.d/10-ssl.conf`
 - Note: these are mainly for POP3s and IMAPs, not SASL in Postfix
 - `service dovecot start`

MTA authentication(4) - Postfix with Dovecot SASL

- Set up Dovecot SASL authenticate (using system account)
 - In `/usr/local/etc/dovecot/conf.d/10-master.conf`:

```
service auth {  
    ...  
    # Postfix smtp-auth  
    unix_listener /var/spool/postfix/private/auth {  
        mode = 0666  
    }  
    ...  
}
```

- In `/usr/local/etc/dovecot/conf.d/10-auth.conf`

```
auth_mechanisms = plain login
```

MTA authentication(5) - Postfix with Dovecot SASL

- Set up Dovecot SASL in Postfix
 - In main.cf

```
# Set SASL to Dovecot
smtpd_sasl_type = dovecot
# Specify the UNIX socket path
smtpd_sasl_path = private/auth
# Enable SASL
smtpd_sasl_auth_enable = yes
# For client (backward) capability
broken_sasl_auth_clients = yes
# Allow SASL authenticated clients
smtpd_recipient_restrictions = permit_mynetworks,
                               permit_sasl_authenticated,
                               reject_unauth_destination
```

- Restart/Reload Dovecot and Postfix

MTA authentication(6)

- Now you can authenticate your identity in SMTP

```
> telnet dem01.nasa.tsaimh.nycucs.net 25
Trying 140.113.168.238...
Connected to dem01.nasa.tsaimh.nycucs.net.
Escape character is '^]'.
220 dem01.nasa.tsaimh.nycucs.net ESMTP Postfix
EHLO linuxhome.cs.nycu.edu.tw
250-dem01.nasa.tsaimh.nycucs.net
250-PIPELINING
250-SIZE 10240000
250-VRFY
250-ETRN
250-AUTH PLAIN LOGIN
250-AUTH=PLAIN LOGIN
250-ENHANCEDSTATUSCODES
250-8BITMIME
250 DSN
```

MTA authentication(7)

- The account and password are encoded in Base64
 - If you have perl installed, suggest your account is **test** and password is **testpassword**

```
perl -MMIME::Base64 -e 'print encode_base64("\000test\000testpassword");'
```

- It will generate encoded account and password
 - For example: AHRlc3QAdGVzdHBhc3N3b3Jk

MTA authentication(8)

- Use the encoded account and password to authenticate it

```
> telnet dem01.nasa.tsaimh.nycucs.net 25
Trying 140.113.168.238...
Connected to dem01.nasa.tsaimh.nycucs.net.
Escape character is '^]'.
220 dem01.nasa.tsaimh.nycucs.net ESMTP Postfix
AUTH PLAIN AHRlc3QAdGVzdHBhc3N3b3Jk
235 2.7.0 Authentication successful
MAIL FROM: tsaimh@nasa.tsaimh.nycucs.net
250 2.1.0 Ok
RCPT TO: tsaimh@gmail.com
250 2.1.5 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
To: tsaimh@gmail.com
Subject: This is authenticated client
Message-Id: <20160307120109.861A9154@dem01.nasa.tsaimh.nycucs.net>
Date: Mon, 7 Mar 2016 15:01:09 +0800 (CST)
From: tsaimh@dem01.nasa.tsaimh.nycucs.net (tsaimh)

Test Mail
.
250 2.0.0 Ok: queued as F3D59171
```

MTA Encryption

The Internet is dangerous, we need to protect ourselves from sniffing.

MTA encryption(1)

- In previous example, all SMTP sessions are in **plain text**
 - Your encoded authentication information is in danger!
- We need encryption over SSL/TLS
 - Like HTTP can be enhanced to HTTPS
 - Postfix supports two kinds of encryption
 - SMTP over TLS
 - SMTPs
- Before we enable SMTP over TLS (or SMTPs), you need SSL keys and certificates
 - Just like HTTPS
 - Self-signed or use Let's Encrypt
 - You can use the same certificates/keys as Dovecot's
 - In main.cf

```
smtpd_tls_cert_file = /path/to/cert.pem  
smtpd_tls_key_file = /path/to/key.pem
```

MTA encryption(2-1) - Set up SMTP over TLS

- Recommended for SMTP encryption
- Use the same port as SMTP (port 25)
- No force encryption
 - Client can choose whether to encrypt mails or not
 - But server can be configured to force encryption
- In main.cf
 - No force encryption

```
smtpd_tls_security_level = may
```
 - Force encryption

```
smtpd_tls_security_level = encrypt
```
- Reload Postfix

MTA encryption(2-2) - Set up SMTP over TLS

- Now your server supports SMTP over TLS

```
> telnet demol.nasa.tsaimh.nycucs.net 25
Trying 140.113.168.238...
Connected to demol.nasa.tsaimh.nycucs.net.
Escape character is '^]'.
220 demol.nasa.tsaimh.nycucs.net ESMTP Postfix
EHLO linuxhome.cs.nycu.edu.tw
250-demol.nasa.tsaimh.nycucs.net
250-PIPELINING
250-SIZE 10240000
250-VRFY
250-ETRN
250-STARTTLS
250-ENHANCEDSTATUSCODES
250-8BITMIME
250 DSN
```

- If you use force encryption, you must STARTTLS before sending mails

```
MAIL FROM: tsaimh@nasa.tsaimh.nycucs.net
530 5.7.0 Must issue a STARTTLS command first
```

MTA encryption(2-3) - Set up SMTP over TLS

- Send mail with STARTTLS
 - You cannot use telnet (plain-text client) anymore
 - Connection becomes encrypted after STARTTLS
 - telnet cannot read encrypted text
- OpenSSL client

```
openssl s_client -connect demo1.nasa.tsaimh.nycucs.net:25 -starttls smtp
```

MTA encryption(3-1) - Set up SMTPs

- Alternative way to encrypt SMTP sessions
- Use different port: 465
- Force encryption
- Can coexist with SMTP over TLS
- In master.cf

- Uncomment these lines

```
smtps      inet n      -      n      -      -      smtpd
  -o syslog_name=postfix/smtps
  -o smtpd_tls_wrappermode=yes
```

- This will open port 465 for SMTPs and use "smtps" as syslog name
- Reload Postfix

MTA encryption(3-2) - Set up SMTPs

- Now you can use SSL clients to use SMTPs

- telnet may not work in encrypted sessions
- SSL client:

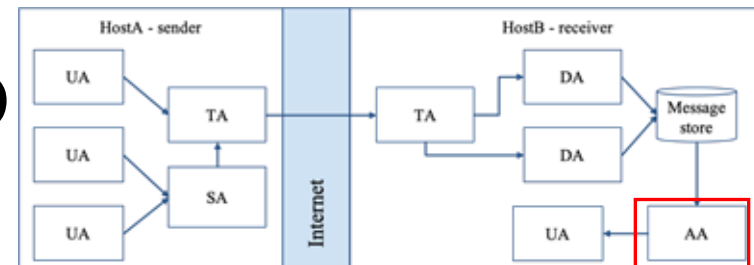
```
openssl s_client -connect host:port
```

- **Important note**

- In openssl s_client, DO NOT use capital character "R"
 - "R" is a special command in openssl s_client (for renegotiating)
- So use "mail from/rcpt to" instead of "MAIL FROM/RCPT TO"
 - For SMTP, they are all the same
- If you use "R", you will see following output (NOT a part of SMTP)

```
RENEGOTIATING
depth=2 O = Digital Signature Trust Co., CN = DST Root CA X3
verify return:1
depth=1 C = US, O = Let's Encrypt, CN = Let's Encrypt Authority X1
verify return:1
depth=0 CN = nasa.tsaimh.nycucs.net
verify return:1
```

MAA for POP3 and IMAP



Read mails from remote host

MAA for POP3 and IMAP (1)

- Dovecot already provides POP3 and IMAP services
 - Include SSL versions: POP3s, IMAPs
 - That's why we need SSL certificates and keys for Dovecot
- When you activate Dovecot service, these MAA services are also brought up.
- But you cannot access mail directly, you need some configuration
 - Configuration files are in : /usr/local/etc/dovecot/
 - There are many files included by dovecot.conf
 - In conf.d directory
 - Splitting configuration files is easier to management
 - Reference: https://doc.dovecot.org/configuration_manual/quick_configuration/

MAA for POP3 and IMAP (2)

- Dovecot Configuration

- Allow GID = 0 to access mail (optional)
 - By default, Dovecot do not allow users with GID = 0 to access mail. If your users are in wheel group, you need following settings
 - In dovecot.conf

```
first_valid_gid = 0
```
- Specify the mail location (must agrees with Postfix)
 - In conf.d/10-mail.conf

```
mail_location = mbox:~/mail:INBOX=/var/mail/%u
```
- Add authenticate configuration to use PAM module
 - Dovecot use system PAM module to authenticate
 - Allow system users to access mails
 - Create a new file: /etc/pam.d/dovecot

```
auth    required    pam_unix.so
account required    pam_unix.so
```

MAA for POP3 and IMAP (3)

- After restarting Dovecot, your MAA is ready
- To check these services, you can use "telnet" or "openssls_client"
 - POP3: 110
 - POP3s: 995
 - IMAP: 143
 - IMAPs: 993

MAA for POP3 and IMAP (4)

- IMAP + STARTTLS

```
openssl s_client -connect host.example.com:143 -starttls imap
```

- POP3 + STARTTLS

```
openssl s_client -connect host.example.com:110 -starttls pop3
```

- IMAPs

```
openssl s_client -connect host.example.com:993
```

- POP3s

```
openssl s_client -connect host.example.com:995
```

- Sample message from Dovecot when succeed

- POP

```
+OK Dovecot ready.
```

- IMAP

```
* OK [CAPABILITY IMAP4rev1 LITERAL+ SASL-IR LOGIN-REFERRALS  
ID ENABLE IDLE AUTH=PLAIN AUTH=LOGIN] Dovecot ready.
```

MAA for POP3 and IMAP (5)

- Set up MUAs like Outlook or Thunderbird
 - You can see the tutorial in CS mail server, they should be similar to set up your server
 - Settings for Gmail is also available
 - <https://it.cs.nycu.edu.tw/mail-receive>