

Postfix

lctseng (2020-2023, CC-BY)

? (?-2019)

國立陽明交通大學資工系資訊中心

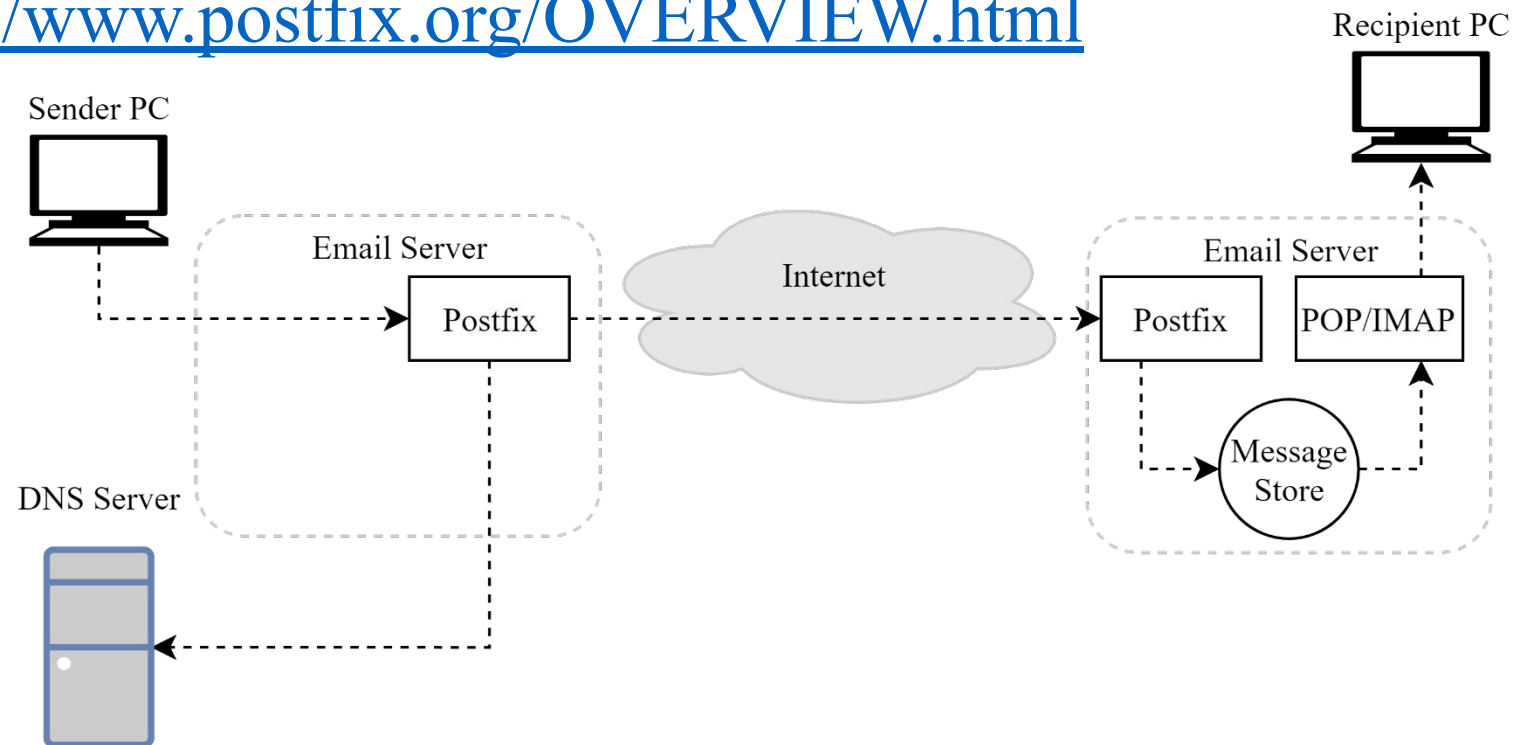
Computer Center of Department of Computer Science, NYCU

Postfix

- Postfix v3.7
 - Latest stable release: 3.7.4 (January, 2023)
 - `/usr/ports/mail/postfix`
 - `pkg install postfix`
- <http://www.postfix.org>
 - <http://www.postfix.org/documentation.html>

Role of Postfix

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



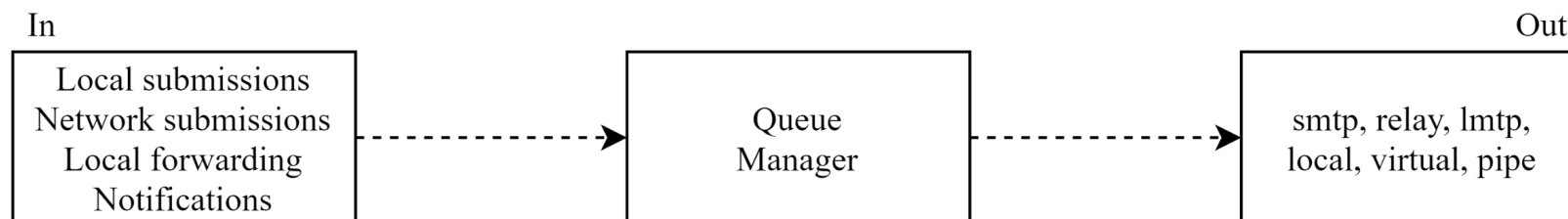
Postfix Architecture

- 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

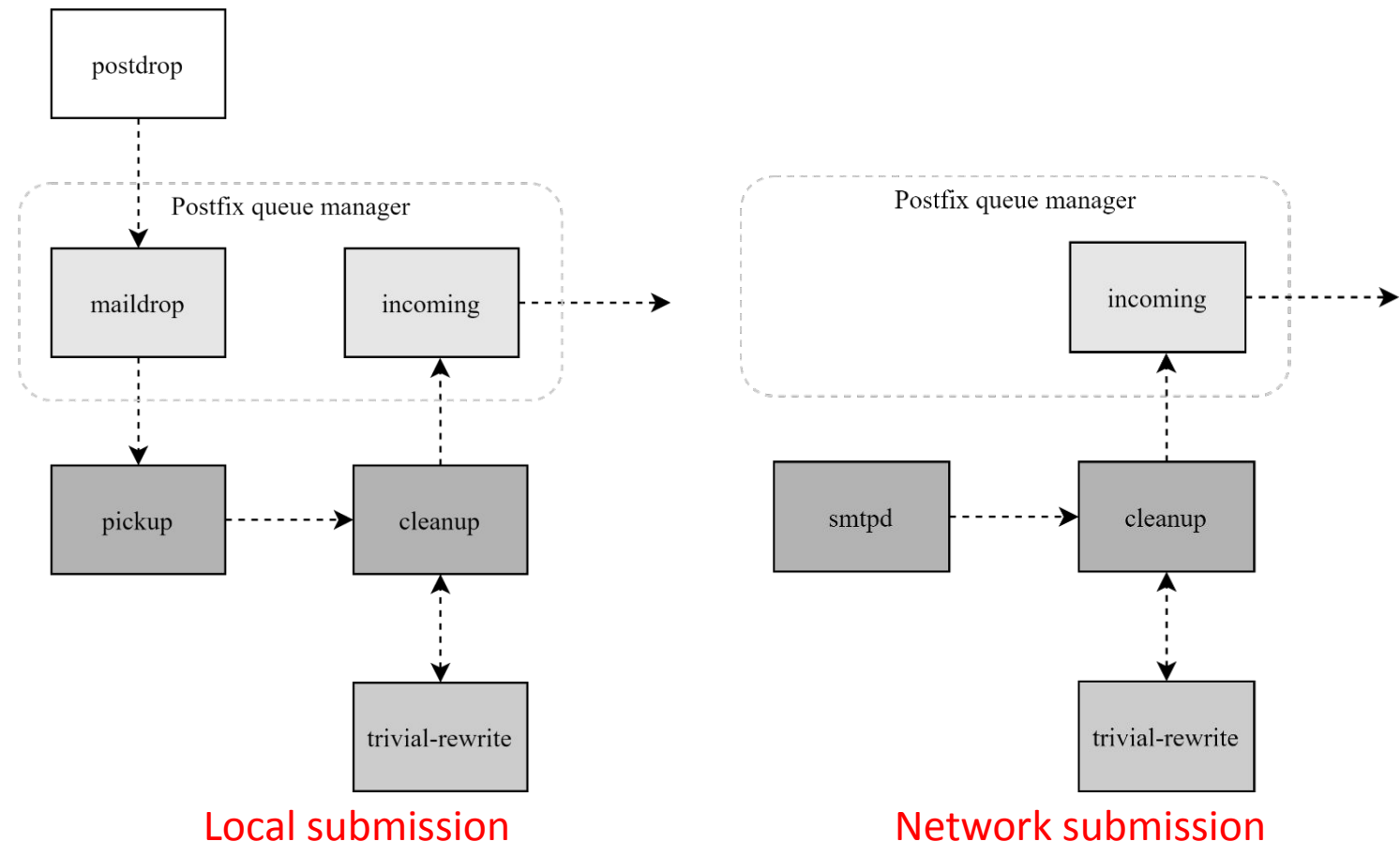
- Major tasks

- Receive mail and put in **queue**
- Queue management
- Delivery mail from queue



Postfix Architecture – Message IN

- Four ways
 - 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



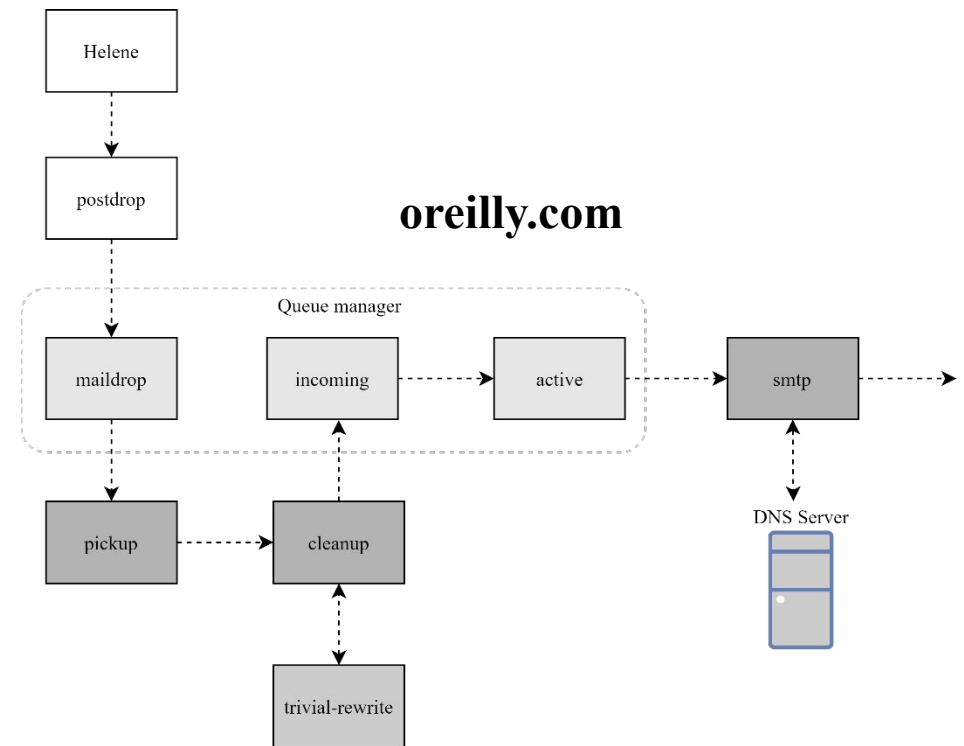
Postfix Architecture – Queue

- Five different queues
 - 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

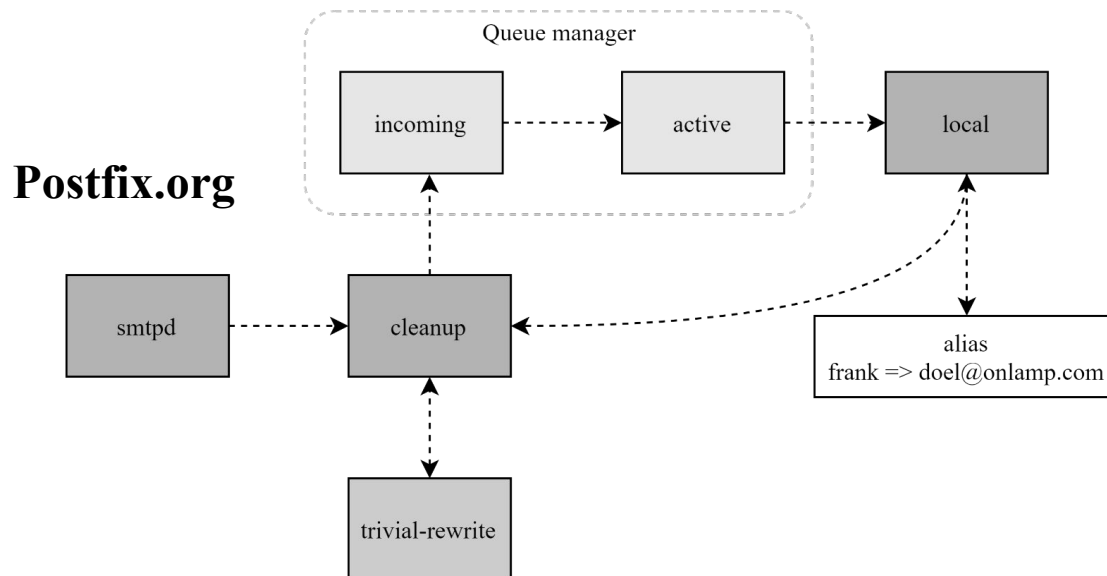
- `helene@oreilly.com => frank@postfix.org (doel@onlamp.com)`
- Phase 1:
 - Compose mail using MUA
 - Call `postdrop` command to send it
 - To “maildrop” queue



Message Flow in Postfix (2)

- Example

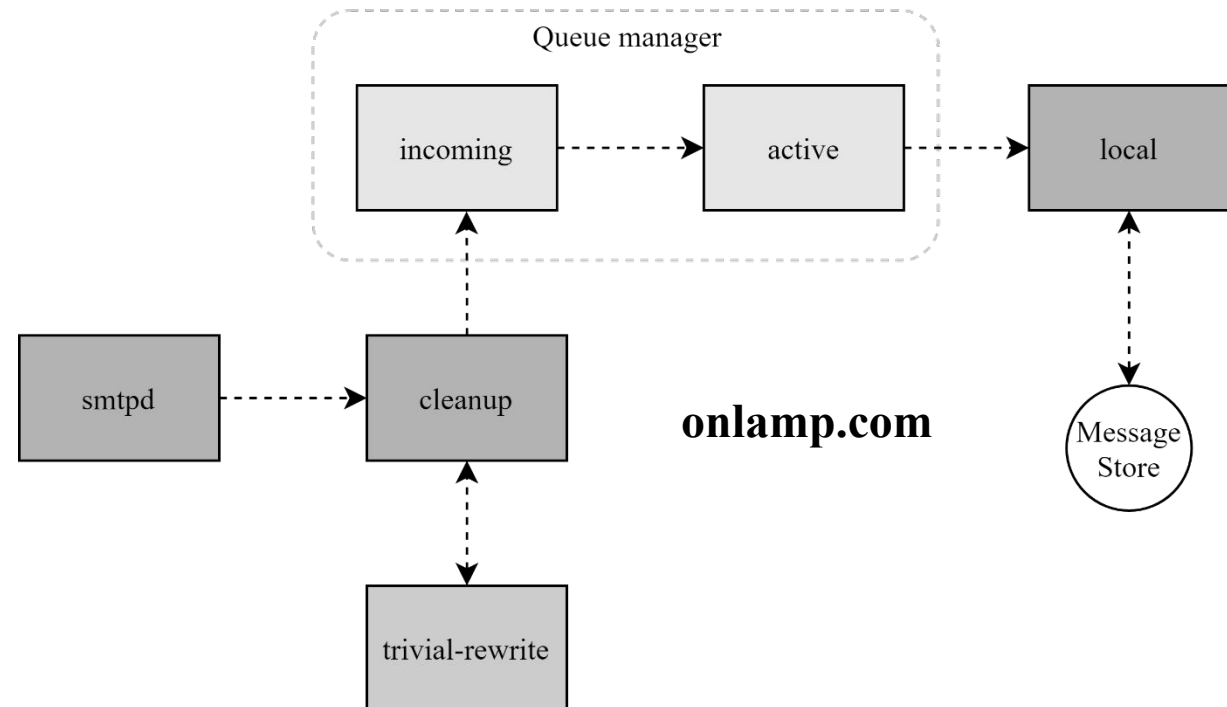
- `frank@postfix.org => doel@onlamp.com`
- Phase2:
 - `smtpd` on `postfix.org`: receive message and invoke `cleanup`
 - “local” MDA find that `frank` is an alias => resubmits it through `cleanup` daemon



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
 - cur: already read
 - new: unread
 - tmp: under receiving (working dir)
 - Maildir format has **scalability** problem
 - locate and delete mails quickly, but waste amounts of fd, inodes, space
 - Problems of quota and backup
- Related parameters (in main.cf)
 - mail_spool_directory = /var/mail (Mbox)
 - mail_spool_directory = /var/mail/ (Maildir)

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

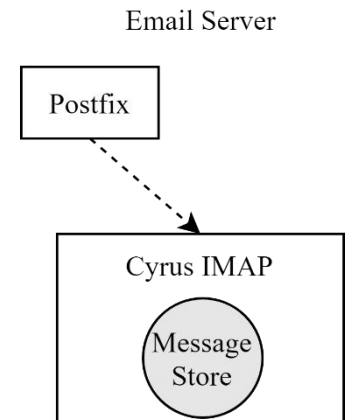
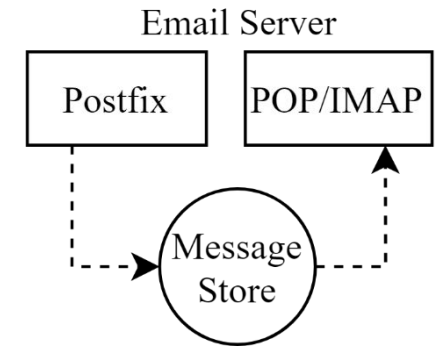
Postfix & POP3/IMAP

- 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
 - Non-standard message store
 - Such as Cyrus IMAP or Dovecot



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.nctu.edu.tw"`
 - `$ postconf -d myhostname` (print default setting)
 - `$ postconf myhostname` (print current setting)
- Reload postfix whenever there is a change
 - `$ postfix reload`

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

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

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 nctu.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\.nctu\.edu\.tw/ \$1@cs.nctu.edu.tw

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

- Four related parameters
 - myhostname
 - ◻ myhostname = nasa.cs.nctu.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
 - This is the CS situation that MX will route mail to mailgate
 - ◻ mydestination = \$myhostname www.\$mydomain, ftp.\$mydomain
 - mydomain
 - ◻ mydomain = cs.nctu.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

- Virtual Alias Map

- 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>lctseng@cs.nctu.edu.tw</code> | <code>@nasa.cs.nctu.edu.tw</code> |
| <code>lctseng</code> | <code>alice@gmail.com</code> |
| <code>@cs.nycu.edu.tw</code> | <code>@cs.nctu.edu.tw</code> |

- Applying regular expression

- `virtual_alias_maps = pcre:/usr/local/etc/postfix/virtual`

- `/^root(\..+)?@(t)?(cs|np)?bsd\d*\.\cs\.\nctu\.\edu\.\tw$/` `bsdta@cs.nctu.edu.tw`

- `/^root(\..+)?@(t)?(cs|np)?linux\d*\.\cs\.\nctu\.\edu\.\tw$/` `linuxta@cs.nctu.edu.tw`

- `/^root(\..+)?@(t)?csmail\w*\d*\.\cs\.\nctu\.\edu\.\tw$/` `mailta@cs.nctu.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
 - Neither 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 `lctseng@smtp.cs.nctu.edu.tw`
- Relay mail for trusted domain
 - E.g. `smtp.cs.nctu.edu.tw` trusts `cs.nctu.edu.tw`

Postfix Configuration – Relay Control (2)

- Restricting relay access by `mynetworks_style`
 - `mynetworks_style = subnet`
 - Allow relaying from other hosts in the same `subnet`, configured in this machine
 - `mynetworks_style = host`
 - Allow relaying for only local 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 provider

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.nctu.edu.tw will be different from csmx1.cs.nctu.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
 - `lctseng => lctseng@nasa.cs.nctu.edu.tw`
 - `append_at_myorigin = yes`
 - To append "mydomain" to address that contain only host.
 - `lctseng@nasa => lctseng@nasa.cs.nctu.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.nctu.edu.tw`
 - `lctseng@subdomain.cs.nctu.edu.tw => lctseng@cs.nctu.edu.tw`
 - `masquerade_domains = !chairman.cs.nctu.edu.tw cs.nctu.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\.\nctu\.\edu\.\tw$/ $1@cs.nctu.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.nctu.edu.tw andyliu@abc.com
 - lctseng EC319, NCTU, Hsinchu, ROC
 - @nabsd.cs.nctu.edu.tw zfs.cs.nctu.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=  
lmtpl unix - - n - - lmtpl  
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
 - `lmtp`
 - 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
 - `domain_or_addresstransport:nextHop`

"Service" defined in master.cf



`csie.nctu.edu.tw smtp:[mailgate.csie.nctu.edu.tw]`

`cs.nctu.edu.tw smtp:[csmailgate.cs.nctu.edu.tw]`

`cis.nctu.edu.tw smtp:[mail.cis.nctu.edu.tw]`

`example.com smtp:[192.168.23.56]:20025`

`orillynet.com smtp`

`ora.com maildrop`

`kdent@ora.com error:no mail accepted for kdent`

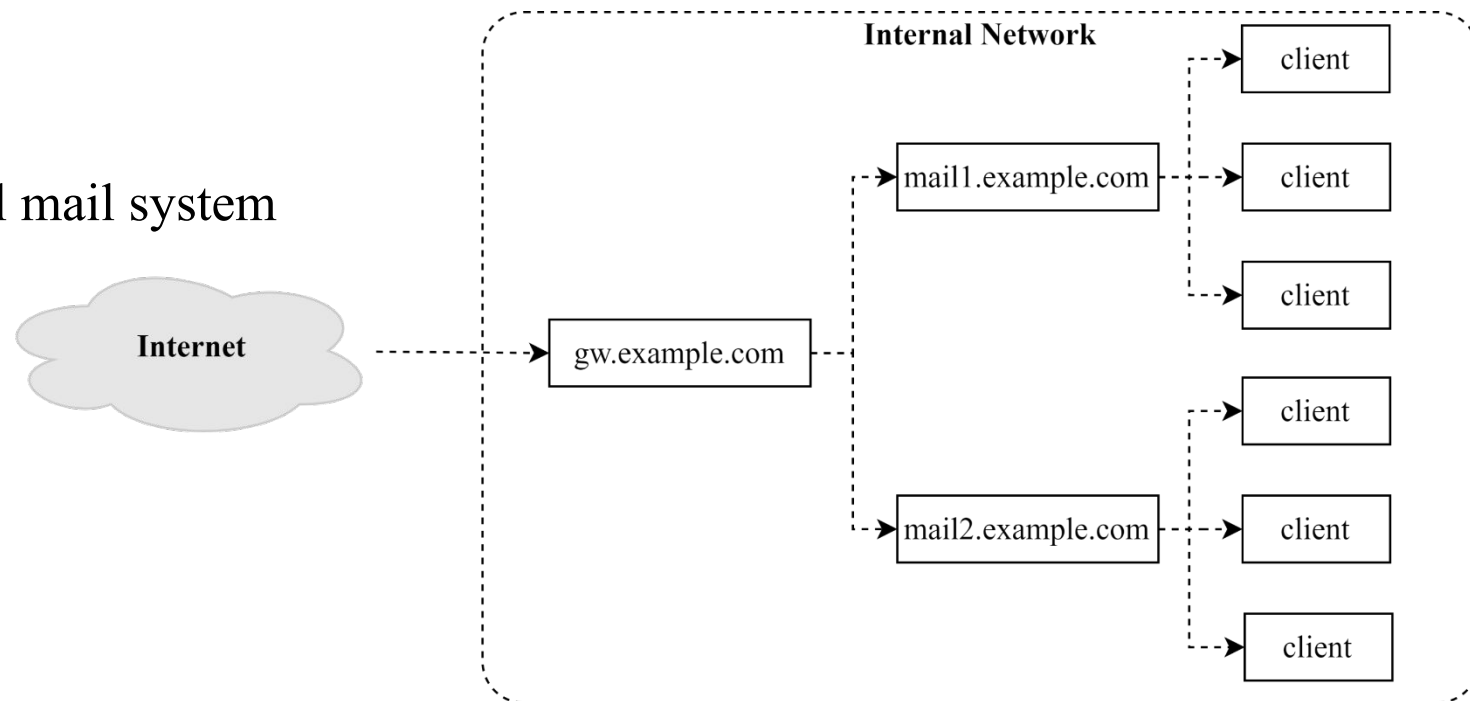
Mail Relaying – Transport Maps (2)

- Usage in transport map

- MX => Local delivery mail server
- mailpost to bbs/news
- Postponing mail relay
 - Such as ISP has to postpone until customer network is online
 - In transport map:
abc.com ondemand
 - In /usr/local/etc/postfix/master.cf
ondemand unix - - n - - smtp
 - In /usr/local/etc/postfix/main.cf
defer_transports = ondemand ← "ondemand" transport should trigger by postqueue
transport_maps = hash:/usr/local/etc/postfix/transport
 - Whenever the customer network is online, do
 - \$ postqueue -s abc.com

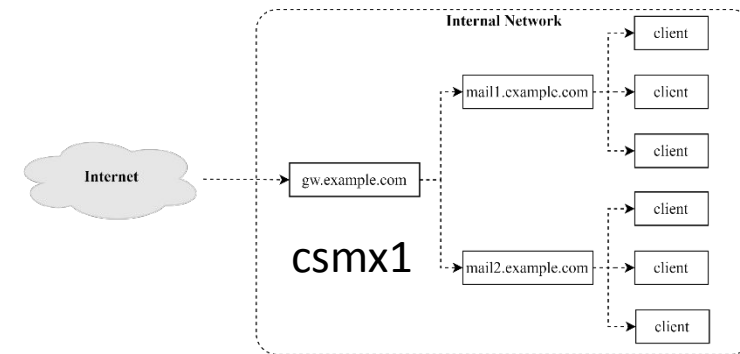
Mail Relaying – Inbound Mail Gateway (1)

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



javaLab
secureLab

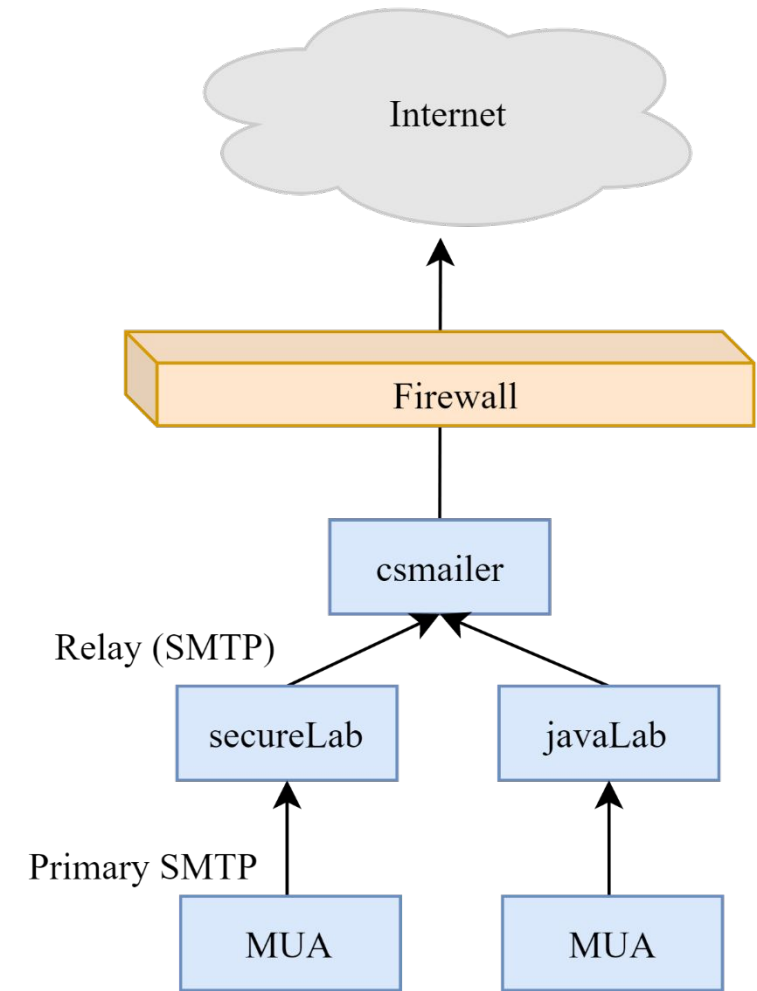
Mail Relaying – Outbound Mail Gateway

- Outbound Mail Gateway
 - Accept mails from inside network and relay them to Internet hosts
- To be OMG, suppose
 - You are administrator for cs.nctu.edu.tw
 - Hostname is csmailer.cs.nctu.edu.tw
 - You have to be the OMG for secureLab.cs.nctu.edu.tw and javaLab.cs.nctu.edu.tw
- 1. In main.cf of csmailer.cs.nctu.edu.tw

```
mynetworks = hash:/usr/local/etc/postfix/mynetworks
```

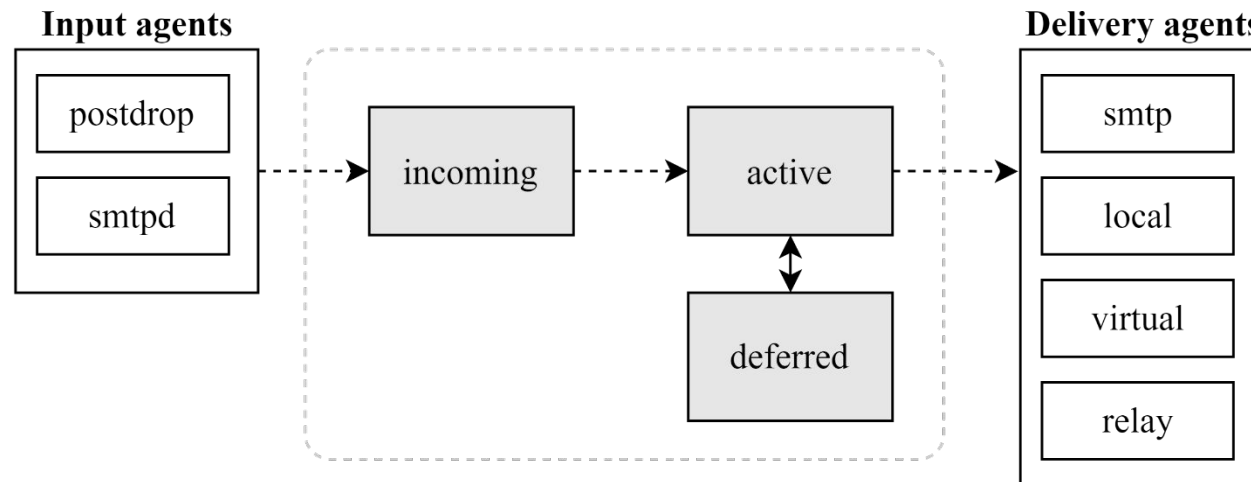
secureLab.cs.nctu.edu.tw
javaLab.cs.nctu.edu.tw
- 2. All students in secureLab/javaLab will configure their MUA to use secureLab/javaLab.cs.nctu.edu.tw to be the SMTP server
- 3. In main.cf of secureLab/javaLab.cs.nctu.edu.tw,

```
relayhost = [csmailer.cs.nctu.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

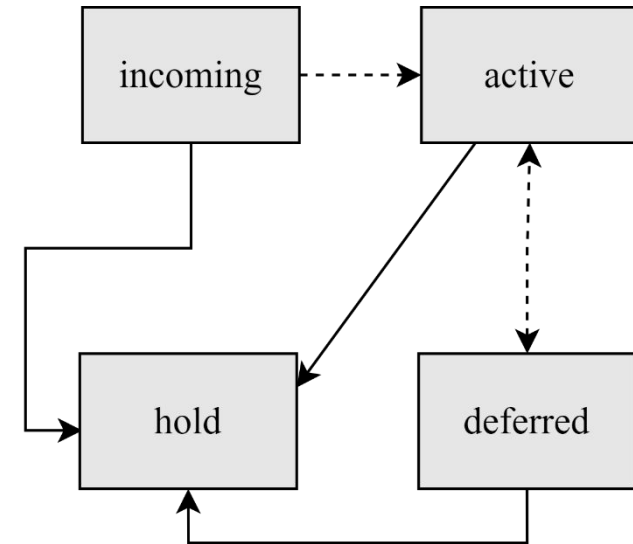
Queue Management – Queue Tools (1)

- [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.nctu.edu.tw`
 - Schedule immediate delivery of all mail queued for site

- [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`



Queue Management – Queue Tools (2)

- [postcat\(1\)](#)
 - Display the contents of a queue file

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

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

Rebuilding locate database:

Rebuilding whatis database:

...
```

Multiple Domains

- Use single system to host many domains
 - E.g.
 - We use csmailgate.cs.nctu.edu.tw to host both **cs.nctu.edu.tw** and **csie.nctu.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 (lctseng@ => /var/mail/lctseng)

- 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.nctu.edu.tw
 - ◻ mydestination = \$myhostname, \$mydomain, csie.nctu.edu.tw

※ In this way, mail to both lctseng@cs.nctu.edu.tw and lctseng@csie.nctu.edu.tw will go to csmailgate:/var/mail/lctseng

- Limitation

- Can not separate lctseng@cs.nctu.edu.tw from lctseng@csie.nctu.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.nctu.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

Step by Step Examples

Let's learn from examples

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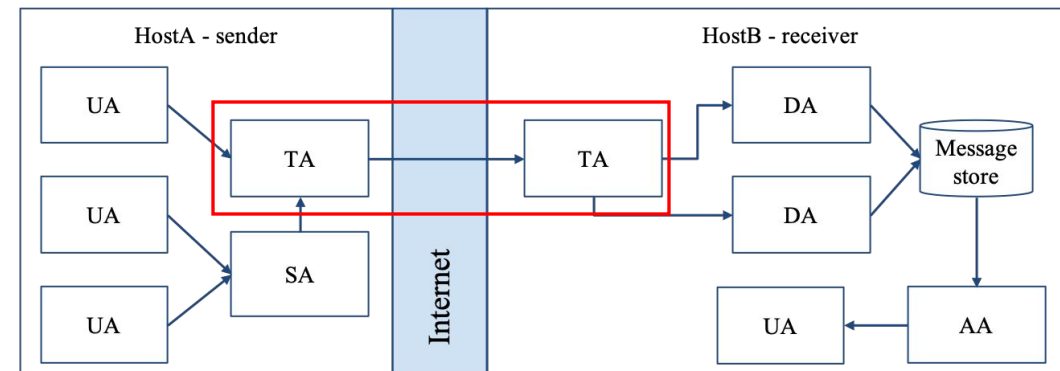
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Step by Step Examples

- 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

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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

```
sendmail_enable="NONE"
```
 - ◻ In /etc/periodic.conf (create if not exists)

```
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
```

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 "demo1.nasa.lctseng.nctucs.net"
 - Set up these records
 - (A record) demo1.nasa.lctseng.nctucs.net
 - (A record) nasa.lctseng.nctucs.net
 - (MX record) nasa.lctseng.nctucs.net
 - Points to "demo1.nasa.lctseng.nctucs.net"

Build a basic MTA(4)

- Set up MTA identity
 - In main.cf

```
myhostname = demo1.nasa.lctseng.nctucs.net
mydomain = nasa.lctseng.nctucs.net
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

```
> telnet localhost 25
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
220 demo1.nasa.lctseng.nctucs.net ESMTP Postfix
EHLO localhost
250-demo1.nasa.lctseng.nctucs.net
250-PIPELINING
250-SIZE 10240000
250-VRFY
250-ETRN
250-ENHANCEDSTATUSCODES
250-8BITMIME
250 DSN
MAIL FROM: lctseng@nasa.lctseng.nctucs.net
250 2.1.0 Ok
RCPT TO: lctseng@cs.nctu.edu.tw
250 2.1.5 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
Subject: This is test mail

DATA
.
250 2.0.0 Ok: queued as 3C868150
```

telnet

Send test mails to verify your MTA(2)

- The "mail" command

```
> mail -s "test from nasa" lctseng@gmail.com  
This is test mail from NASA  
regards,  
admin  
(Press Ctrl+D)
```

mail

- See man page for more details

- Result (gmail)

test from nasa



收件匣 x



lctseng <lctseng@nasa.lctseng.nctucs.net>

寄給我



英文



中文 (繁體)

翻譯郵件

This is test mail from NASA
regards,
admin

Send test mails to verify your MTA(3)

- Mail source text of the previous example

```
Delivered-To: lctseng@gmail.com
Received: by 10.129.125.135 with SMTP id y129csp874822ywc;
      Sun, 6 Mar 2016 02:39:22 -0800 (PST)
X-Received: by 10.98.87.90 with SMTP id 187mr25639644pfb.70.1457260762400;
      Sun, 06 Mar 2016 02:39:22 -0800 (PST)
Return-Path: <lctseng@nasa.lctseng.nctucs.net>
Received: from demo1.nasa.lctseng.nctucs.net ... (omitted)
      by mx.google.com with ESMTP id bz6si20406744pad.30.2016.03.06.02.39.21
      for <lctseng@gmail.com>;
      Sun, 06 Mar 2016 02:39:21 -0800 (PST)
Received-SPF: neutral (google.com: 140.113.168.238 is neither permitted ... (omitted))
Authentication-Results: mx.google.com;
      spf=neutral (google.com: 140.113.168.238 is neither permitted ... (omitted))
Received: by demo1.nasa.lctseng.nctucs.net (Postfix, from userid 1001)
      id 6D916162; Sun, 6 Mar 2016 18:38:04 +0800 (CST)
To: lctseng@gmail.com
Subject: test from nasa
Message-Id: <20160306103804.6D916162@demo1.nasa.lctseng.nctucs.net>
Date: Sun, 6 Mar 2016 18:38:04 +0800 (CST)
From: lctseng@nasa.lctseng.nctucs.net (lctseng)

This is test mail from NASA
regards,
admin
```

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.nctu.edu.tw)

```
-Queue ID- --Size-- ----Arrival Time---- -Sender/Recipient-----  
3C868150      377 Sun Mar  6 18:23:11 lctseng@nasa.lctseng.nctucs.net  
(host csmx3.cs.nctu.edu.tw[140.113.235.119] said: 450 4.1.8  
<lctseng@nasa.lctseng.nctucs.net>: Sender address rejected: Domain not found  
(in reply to RCPT TO command) lctseng@cs.nctu.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 lctseng@nasa.lctseng.nctu.cs.net  
(host csmx1.cs.nctu.edu.tw[140.113.235.104] said: 450 4.2.0  
<lctseng@cs.nctu.edu.tw>: Recipient address rejected: Greylisted,  
  see http://postgrey.schweikert.ch/help/cs.nctu.edu.tw.html  
  (in reply to RCPT TO command))      lctseng@cs.nctu.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

MTA Authentication

We don't want unauthorized user to access our MTA

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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 demol.nasa.lctseng.nctucs.net 25
Trying 140.113.168.238...
Connected to demol.nasa.lctseng.nctucs.net.
Escape character is '^]'.
220 demol.nasa.lctseng.nctucs.net ESMTTP Postfix
MAIL FROM: lctseng@demol.nasa.lctseng.nctucs.net
250 2.1.0 Ok
RCPT TO: lctseng@gmail.com
454 4.7.1 <lctseng@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 demol.nasa.lctseng.nctucs.net 25
Trying 140.113.168.238...
Connected to demol.nasa.lctseng.nctucs.net.
Escape character is '^]'.
220 demol.nasa.lctseng.nctucs.net ESMTPostfix
EHLO linuxhome.cs.nctu.edu.tw
250-demol.nasa.lctseng.nctucs.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 demol.nasa.lctseng.nctucs.net 25
Trying 140.113.168.238...
Connected to demol.nasa.lctseng.nctucs.net.
Escape character is '^]'.
220 demol.nasa.lctseng.nctucs.net ESMTP Postfix
AUTH PLAIN AHRlc3QAdGVzdHBhc3N3b3Jk
235 2.7.0 Authentication successful
MAIL FROM: lctseng@nasa.lctseng.nctucs.net
250 2.1.0 Ok
RCPT TO: lctseng@gmail.com
250 2.1.5 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
To: lctseng@gmail.com
Subject: This is authenticated client
Message-Id: <20160307120109.861A9154@demol.nasa.lctseng.nctucs.net>
Date: Mon, 7 Mar 2016 15:01:09 +0800 (CST)
From: lctseng@demol.nasa.lctseng.nctucs.net (lctseng)

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

MTA Encryption

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

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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 dem01.nasa.lctseng.nctucs.net 25
Trying 140.113.168.238...
Connected to dem01.nasa.lctseng.nctucs.net.
Escape character is '^]'.
220 dem01.nasa.lctseng.nctucs.net ESMTP Postfix
EHLO linuxhome.cs.nctu.edu.tw
250-dem01.nasa.lctseng.nctucs.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: lctseng@nasa.lctseng.nctucs.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.lctseng.nctucs.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:

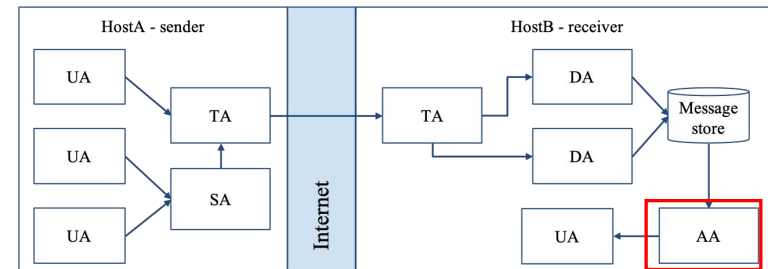
```
openssl s_client -connect host:port
```

- **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.lctseng.nctucs.net
verify return:1
```

MAA for POP3 and IMAP



Read mails from remote host

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MAA for POP3 and IMAP (1)

- Dovecot already provides POP3 and IMAP services
 - Include SSL versions: POP3s, IMAPs
 - That 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
- Specify the mail location (must agrees with Postfix)
 - In conf.d/10-mail.conf
- 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

```
first_valid_gid = 0
```

```
mail_location = mbox:~/mail:INBOX=/var/mail/%u
```

```
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 "openssl s_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>