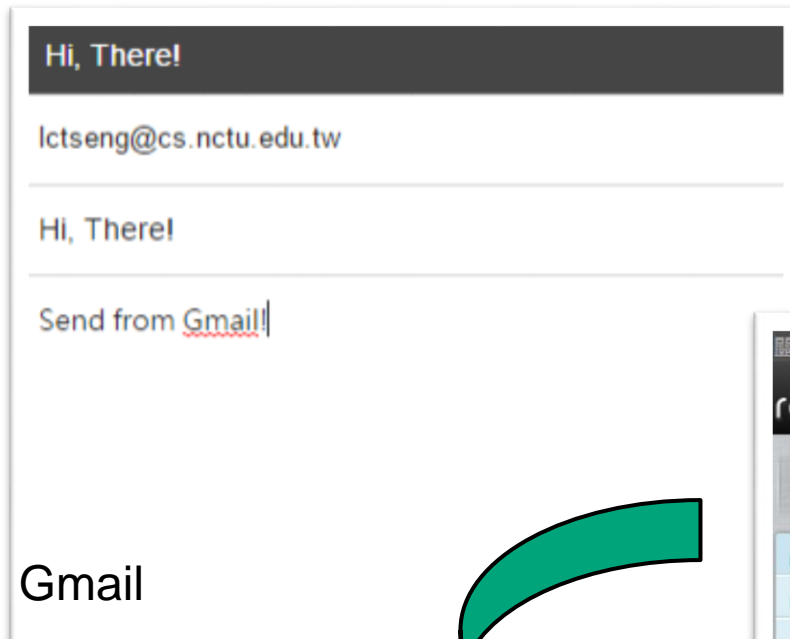


Mail System

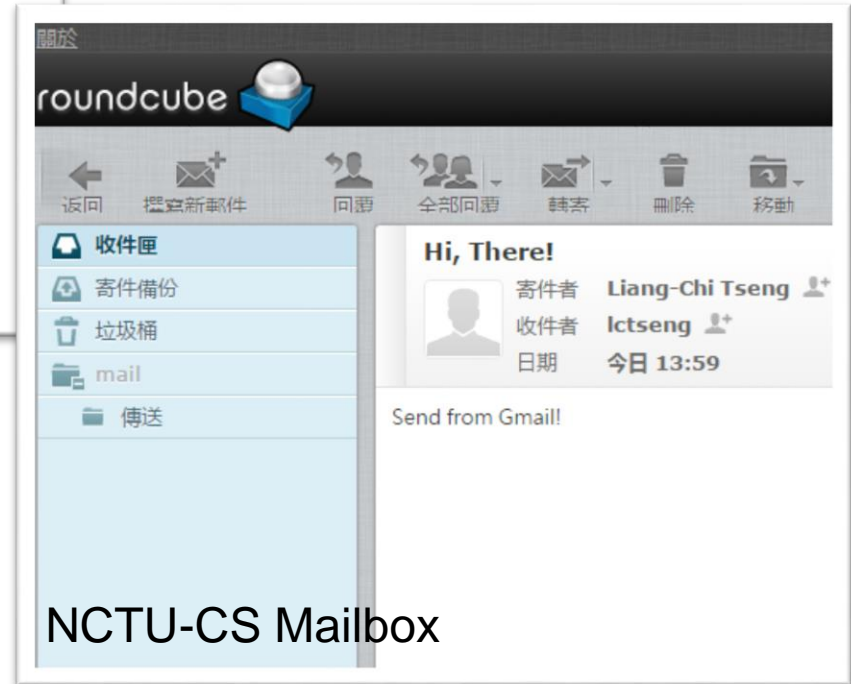
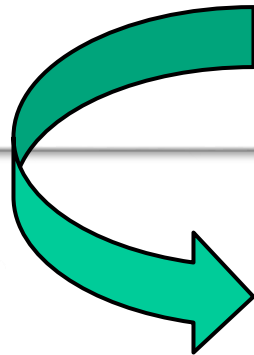
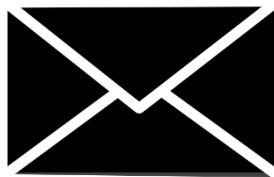
lctseng / Liang-Chi Tseng

Mail System

- ❑ What behinds the scene when you send an email?



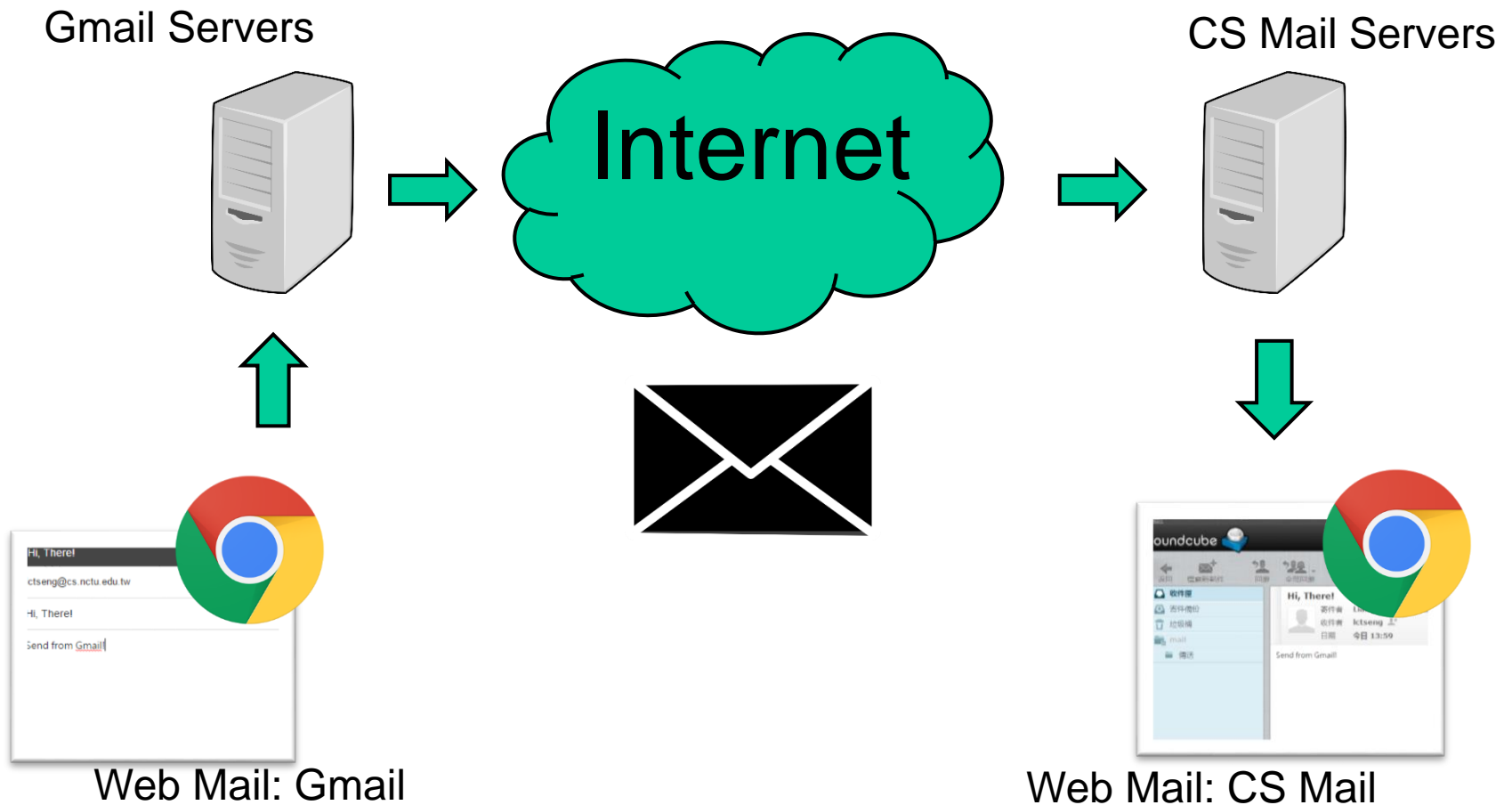
Gmail



NCTU-CS Mailbox

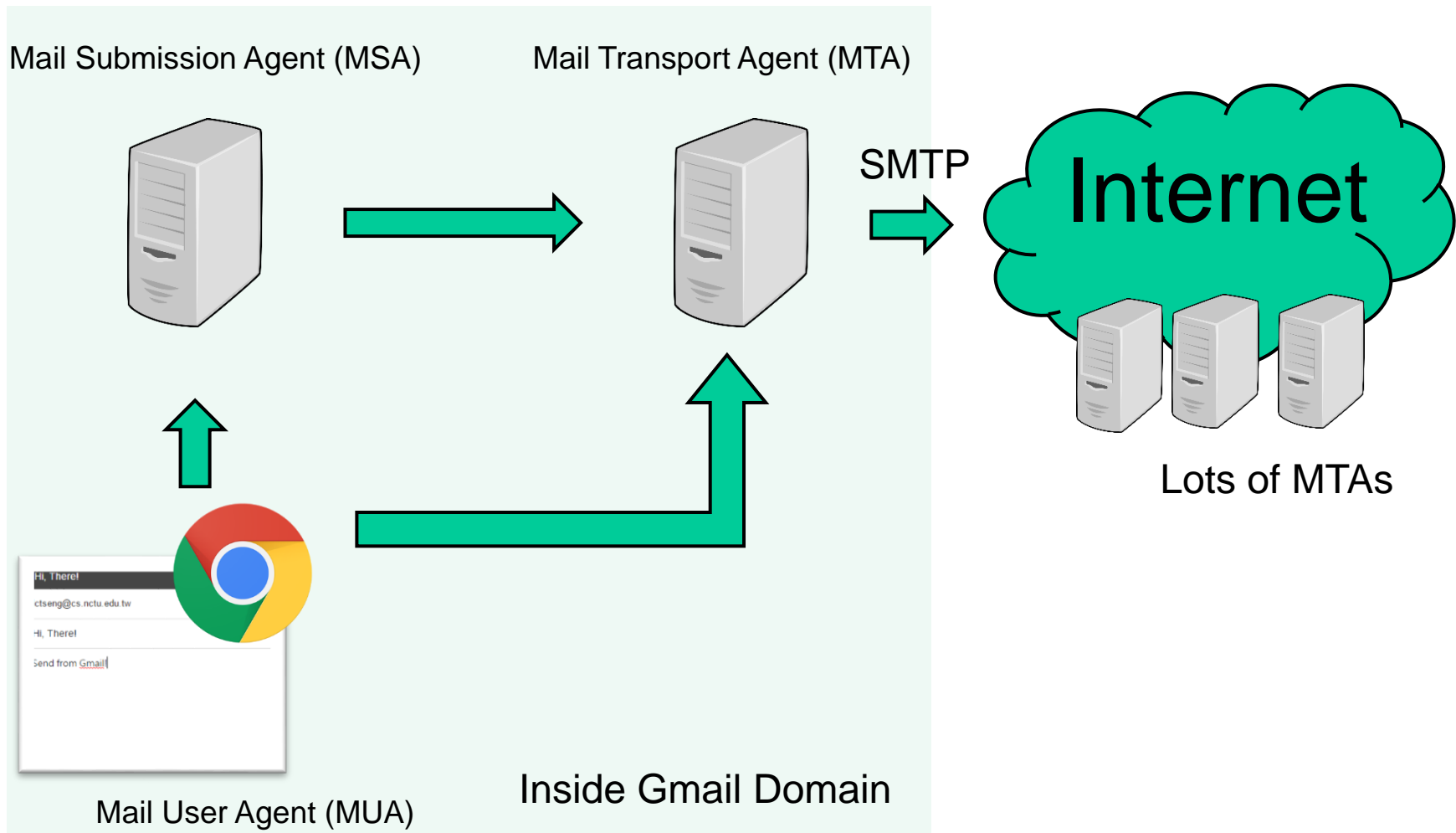
Mail System

- ❑ What behinds the scene when you send an email?



Mail System

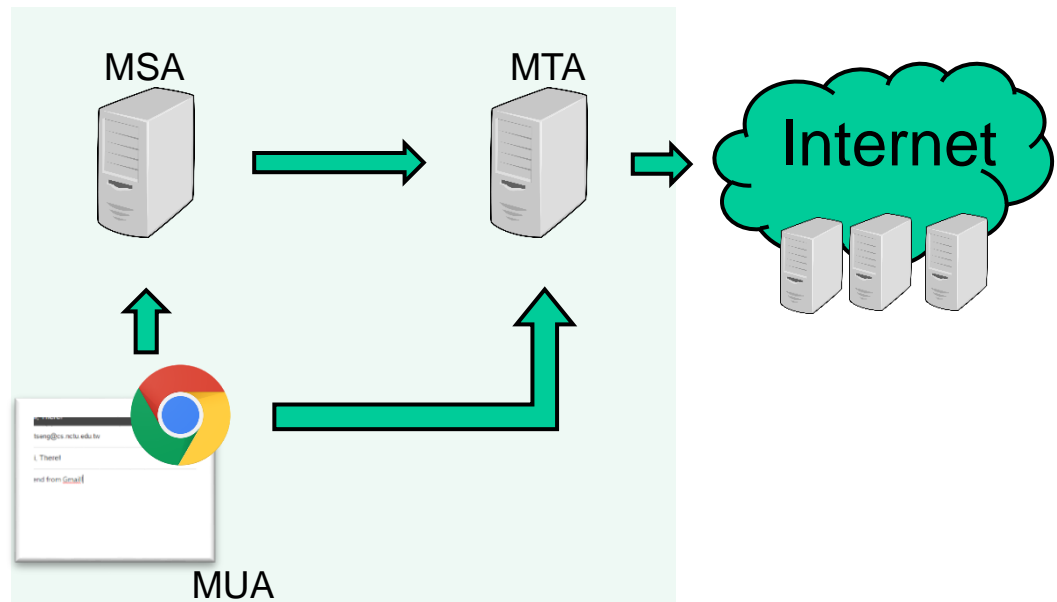
- More detailed view (outgoing, for illustration only)



Mail System

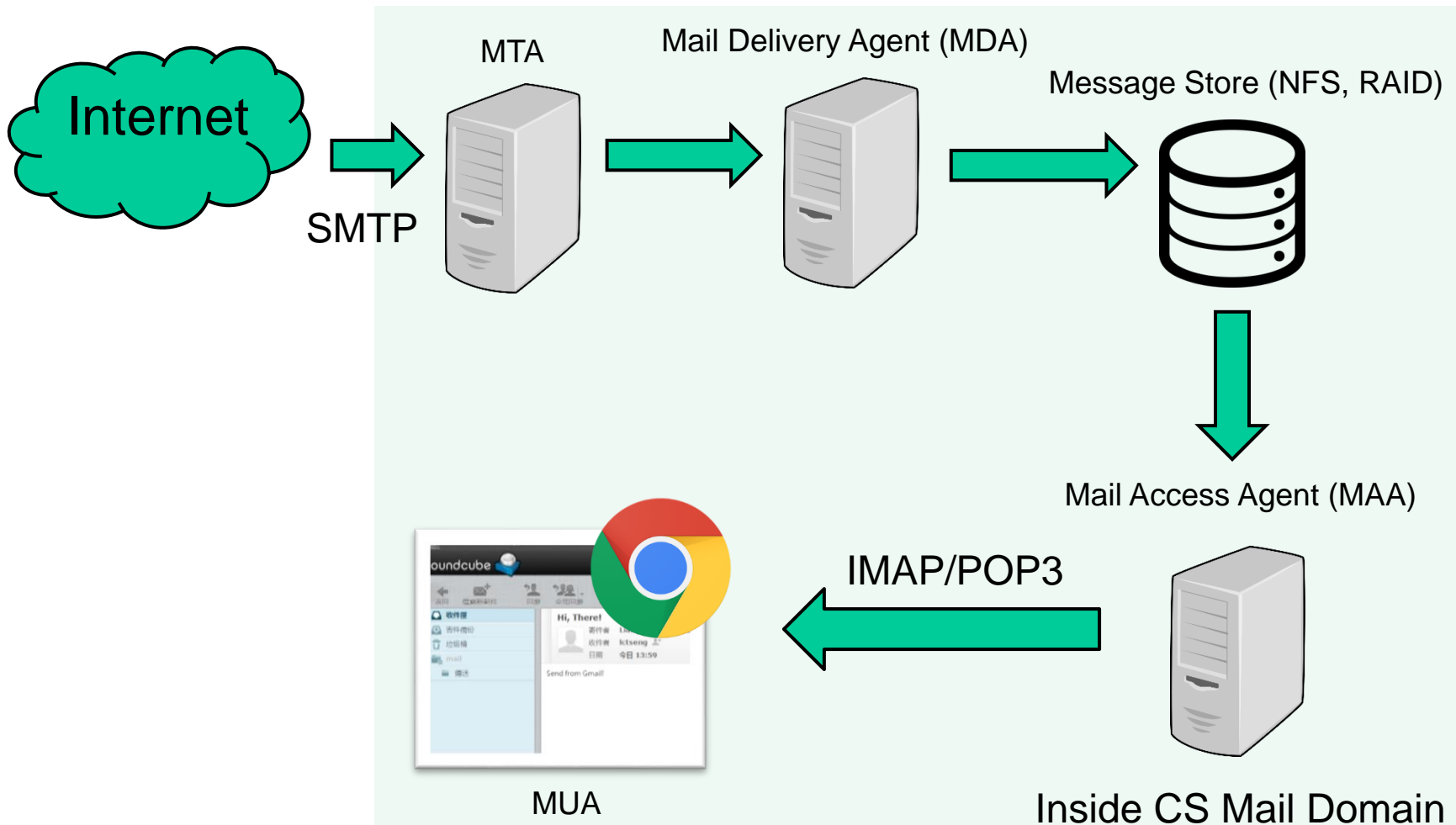
❑ More detailed view (outgoing, for illustration only)

- Mail User Agent (MUA)
 - Help user read and compose mails
- Mail Submission Agent (MSA)
 - Route mails to local MTA
- Mail Transport Agent (MTA)
 - Route mails among machines, using SMTP protocol



Mail System

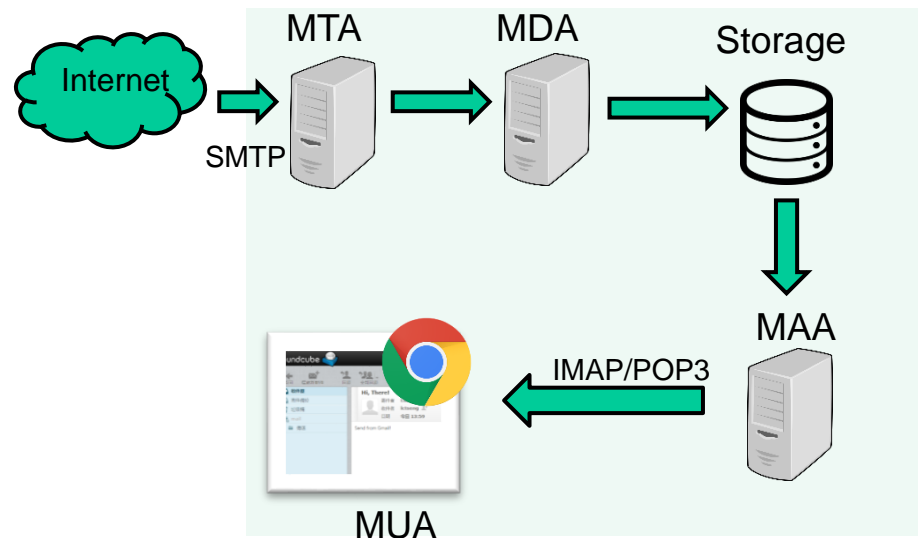
- More detailed view (incoming, for illustration only)



Mail System

□ More detailed view (incoming, for illustration only)

- Mail Delivery Agent (MDA)
 - Place mails in users' mail boxes
- Mail Access Agent (MAA)
 - Connects the user agent to the mail box using POP or IMAP protocols

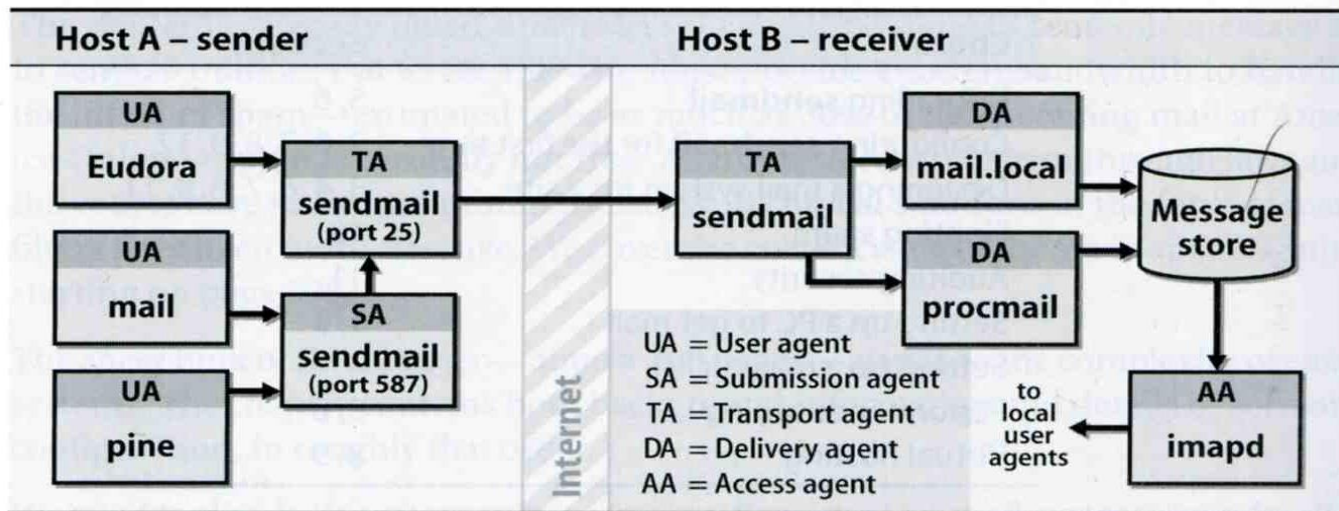


Mail System

Major components

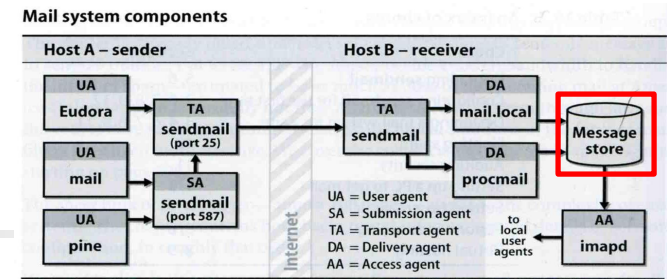
- Mail User Agent (MUA)
 - Help user read and compose mails
 - Outlook, web mail, Eudora...
- Mail Transport Agent (MTA)
 - Route mails among machines
- Mail Delivery Agent (MDA)
 - Place mails in users' mail boxes
 - Filter spam, virus...
- Mail Access Agent (MAA)
 - Connects the user agent to the mail box using POP or IMAP protocols
- Mail Submission Agent (MSA)
 - Route mails to local MTA
 - Filter spam or virus before MUA sends mails to MTA

Mail system components



Mail System

– The Message Stores



❑ The place on the local machine where email is stored

- Usually the directory: /var/mail or /var/spool/mail
 - Users' mails are stored in files named with each user's login name
 - Such as /var/mail/lctseng
 - Permission "775" and root:mail as the owner and group owner
 - drwxrwxr-x 2 root mail 512 Dec 16 15:51 mail/
 - For special mail programs
- Using database
 - When the organization is large or for ISP with millions of customers
 - Better performance

Mail System

– The User Agent (UA) (1)

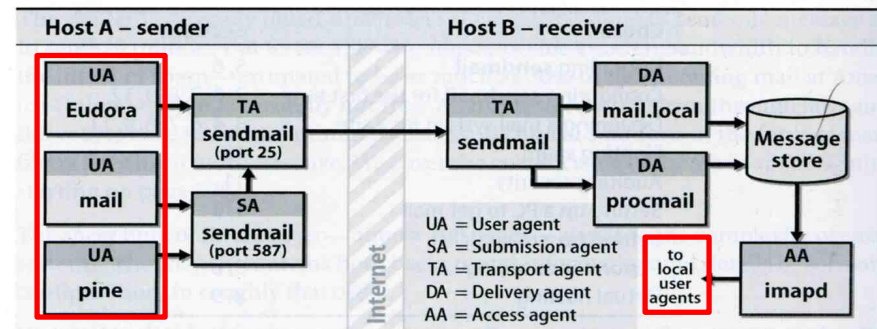
□ Help user read and compose mails

- UA must know mail format
 - Originally: Text only
 - Now: MIME (for multi-media)

※ MIME (Multipurpose Internet Mail Extensions)

- Include several types of content that can be encoded in the mail, such as image, video, ...

Mail system components



Mail System

- The User Agent (UA) (2)

- Popular Mail User Agents

User Agent	System Config.	User Config.	MIME	POP	IMAP	SMTP
bin/mail	mail.rc	.mailrc				
pine	pine.conf	.pinerc	✓	✓	✓	✓
elm	lib/elm.rc	.elm/elmrc	✓	✓	✓	
mutt	/etc/Muttrc	.muttrc	✓	✓	✓	
Netscape	-	-	✓	✓	✓	✓
Eudora	-	-	✓	✓	✓	✓
Outlook Ep.	-	-	✓	✓	✓	✓

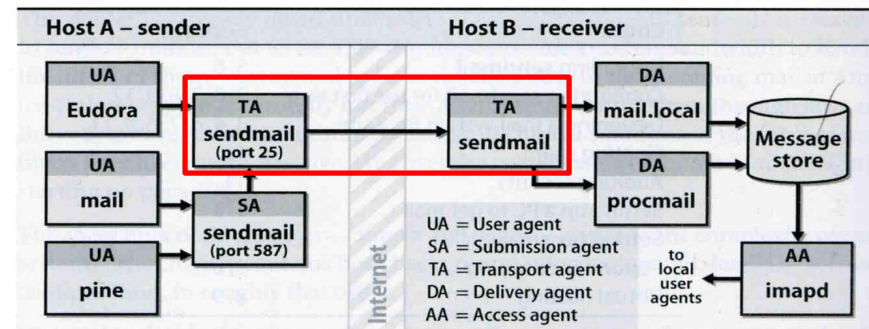
Mail System

– The Transport Agent (TA) (1)

❑ Route mails among machines

- Accept mail from UA, examine the recipients' addresses, and delivery the mail to the correct host
- Protocols
 - SMTP (Simple Mail Transport Protocol)
 - RFC 821
 - Easy to be broke
 - ESMTP (Extended SMTP)
 - RFC 1869, 1870, 1891, 1985
- Popular transport agents
 - sendmail
 - <http://www.sendmail.org/>
 - Postfix
 - <http://www.postfix.org/>

Mail system components



Mail System

- The Transport Agent (TA) (2)

□ Conversation between TAs

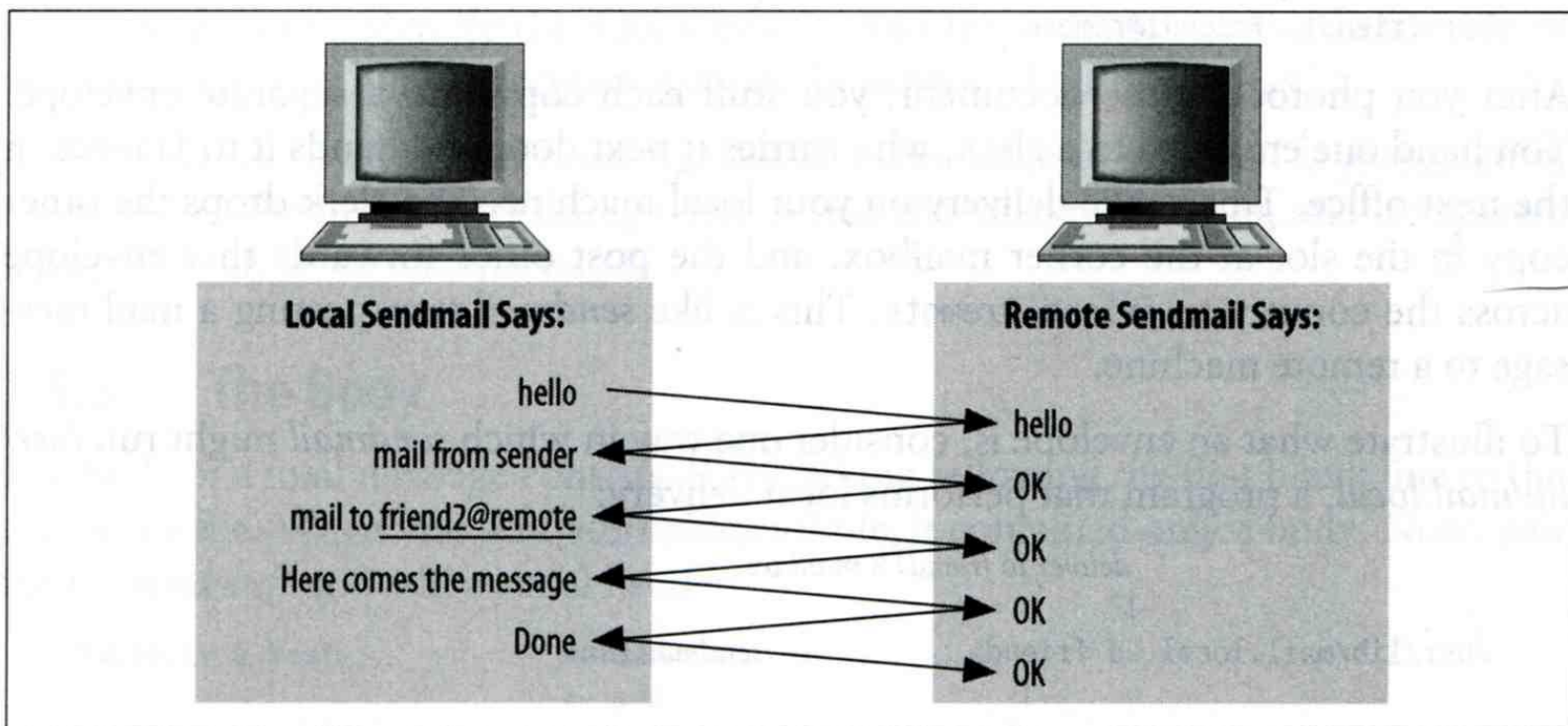


Figure 1-2. A simplified conversation

Mail System

- The Transport Agent (TA) (3)

❑ Protocol: SMTP

```
chbsd [/home/chwong] -chwong- telnet chbsd.cs.nctu.edu.tw 25
Trying 140.113.17.212...
Connected to chbsd.cs.nctu.edu.tw.
Escape character is '^]'.
220 chbsd.cs.nctu.edu.tw ESMTP Sendmail 8.13.8/8.13.8; Sun, 15 Apr 2007 13:50:16 +0800 (CST)
HELP
214-2.0.0 This is sendmail version 8.13.8
214-2.0.0 Topics:
214-2.0.0   HELO  EHLO  MAIL  RCPT  DATA
214-2.0.0   RSET  NOOP  QUIT  HELP  VRFY
214-2.0.0   EXPN  VERB  ETRN  DSN   AUTH
214-2.0.0   STARTTLS
214-2.0.0 For more info use "HELP <topic>".
214-2.0.0 To report bugs in the implementation see
214-2.0.0   http://www.sendmail.org/email-addresses.html
214-2.0.0 For local information send email to Postmaster at your site.
214 2.0.0 End of HELP info
HELO chbsd
250 chbsd.cs.nctu.edu.tw Hello chbsd.csie.nctu.edu.tw [140.113.17.212], pleased to meet you
QUIT
221 2.0.0 chbsd.cs.nctu.edu.tw closing connection
Connection closed by foreign host.
```

Mail System

- The Transport Agent (TA) (4)

❑ Example of sending an email via telnet

```
220 nasa.cs.nctu.edu.tw ESMTP Postfix
EHLO somehost.my.domain
250-nasa.cs.nctu.edu.tw
250-PIPELINING
250-SIZE 10240000
250-VRFY
250-ETRN
250-STARTTLS
...
MAIL FROM: someone@nctucs.tw
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: Hi, there!
From: yourfriend@google.com
To: you@your.home
Hi! This is a test mail
.
250 2.0.0 Ok: queued as 76818366B292
```

Some lines omitted

Mail header

Must have empty line after header

Mail System

- The Transport Agent (TA) (5)

- ❑ Obviously, we send a fake mail in the last page
 - With fake sender and receiver
 - Just like spam mails!

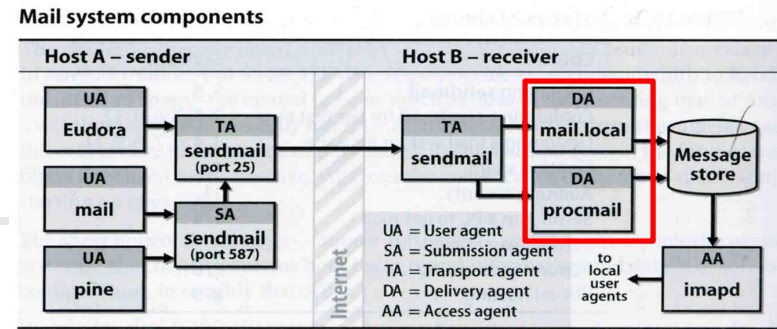


Mail System

– The Delivery Agent (DA)

☐ Place mails in users' mail boxes

- Accept mail from MTA and deliver the mail to the local recipients
- Type of recipients
 - User
 - Program, such as
 - mail.local
 - procmail
- mail.local
 - Read the stdin up to an EOF and appends it to each user's mail file
- procmail
 - Do something between mail coming in and stored in mail box
 - Spam filter
 - CS: <http://www.cs.nctu.edu.tw/help/procmail.htm>



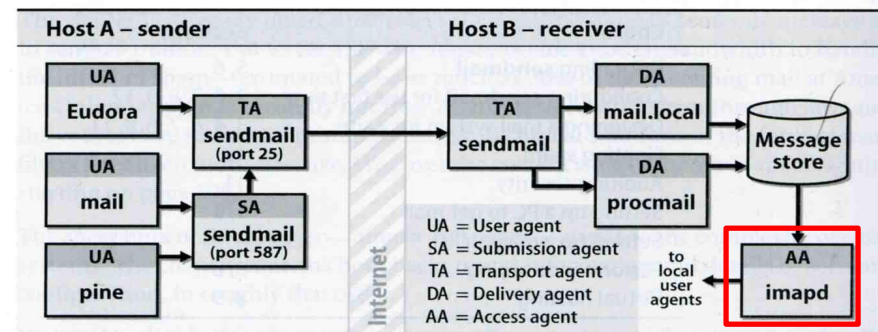
Mail System

– The Access Agent (AA)

❑ Help user download mail from server

- Protocols
 - IMAP (Internet Message Access Protocol)
 - Support both “online” and “offline” mode
 - Synchronize with server
 - POP (Post Office Protocol)
 - Download mails from server

Mail system components

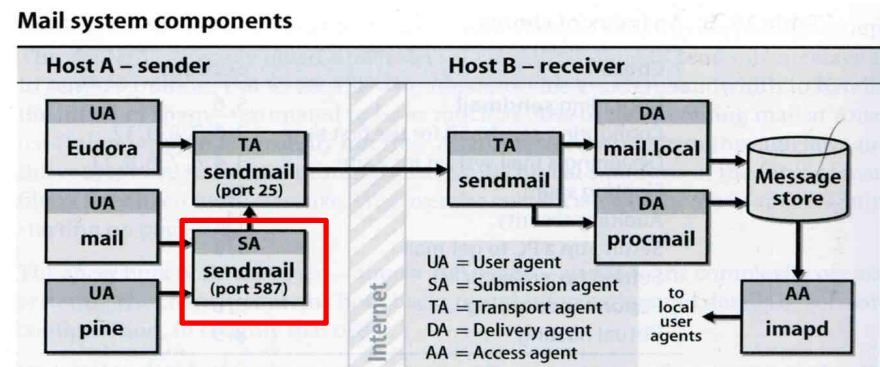


Mail System

– The Submission Agent (SA)

❑ Route mails to local MTA

- Typical works that a MTA must do:
 - Ensuring that all hostname are fully qualified
 - Modifying headers
 - E.g. remove the hostname (bsd5.cs.nctu.edu.tw → cs.nctu.edu.tw)
 - Logging errors
 - Filter spam and virus
 - ...
- RFC2476 introduces the idea of splitting MTA
 - Let SA to share the load
 - Avoid abuse on MTA



Components of a Mail (1)

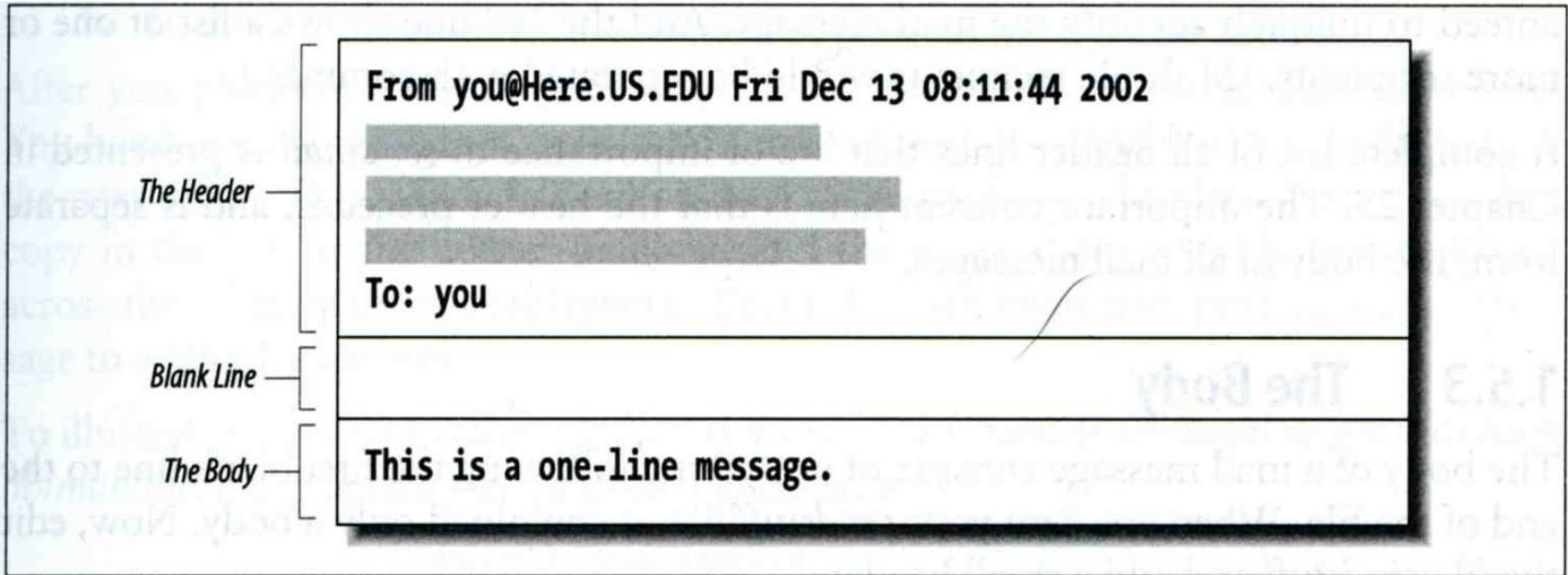


Figure 1-1. Every mail message is composed of a header and a body

Components of a Mail (2)

❑ Three major components

- The envelope
 - Invisible to users
 - Determine where the message should be delivered, or to whom it should be returned

The letter

- The headers
 - Information about the messages, defined in RFC822
 - From, To, Date, Time, MTA, ...
- The message body
 - Plain text only
 - Various MIME contents are encoded as printable characters using radix-64 algorithm

MUA usually shows information of letter, **not envelope**

Mail Addressing (1)

□ Two kinds of email addresses:

- Route based address
 - Message will travel through several intermediate hosts to the destination
 - Format: host!path!user
 - Ex: castle!sun!sierra!hplabs!ucbvax!winsor
 - This mail is sent from “castle” host to the user “winsor” at “ucbvax” host
- Location independent address
 - Simply identify the final destination
 - Format: user@host.domain
 - Ex: lctseng@nabsd.cs.nctu.edu.tw

□ Alias

- Map a username to something else, such as
 - To a group of users (easy to management)
 - Ex: *ta* → *lctseng*, *yench*, *chchang2222*, ...
 - To the same user at different machine
 - Ex: *lctseng@nasa.cs.nctu.edu.tw* → *lctseng@cs.nctu.edu.tw*
 - To another user (or another domain)
 - Ex: *admin@some.domain* → *lctseng@cs.nctu.edu.tw*

Mail Addressing (2)

-- (Mail eXchanger, mx)

□ Where to send the mail?

- When you want to send the mail to `lctseng@cs.nctu.edu.tw`, the MTA will:
 - First, lookup up the mail exchanger (DNS Record) of "cs.nctu.edu.tw"
 - % `dig mx cs.nctu.edu.tw`

```
nasa [/home/lctseng] -lctseng- dig mx cs.nctu.edu.tw
```

```
:: ANSWER SECTION:
```

```
cs.nctu.edu.tw.  7200  IN  MX  5 csmx2.cs.nctu.edu.tw.
cs.nctu.edu.tw.  7200  IN  MX  10 csmx3.cs.nctu.edu.tw.
cs.nctu.edu.tw.  7200  IN  MX  5 csmx1.cs.nctu.edu.tw.
```

- If there is any servers, choose the higher preference one (lower value)
- If this preferred one can not be connected, choose another
- If all the mx servers can not be connected (or not available), mail it directly to the host

Mail Addressing (3)

-- (Mail eXchanger, mx) (2)

□ Why using "Mail eXchanger"?

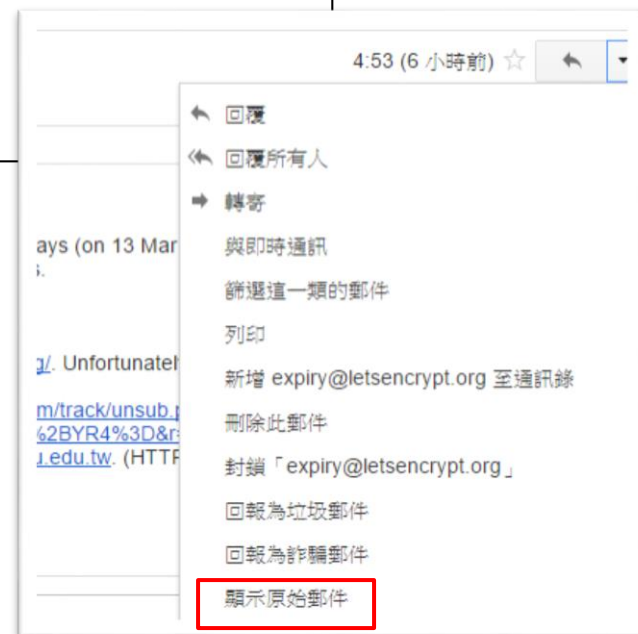
- We can centralize all the mail tasks to group of servers
- Multiple mail exchangers make it more robust

Mail Headers (1)

- ❑ Defined by RFC822 which is obsoleted by RFC2822
 - Mail reader will hide some uninteresting header information

Date: Wed, 18 Apr 2007 14:05:04 +0800
From: 大小姐 <lkg-girl@mail.richhome.net>
Subject: 笑狗好可怕
To: Liang-Chi Tseng <lctseng@nabsd.cs.nctu.edu.tw>
User-Agent: Mutt/1.5.15 (2007-04-06)

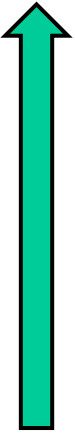
你趕快把牠趕跑好不好？



Mail Headers (2)

From lctseng@chbsd.cs.nctu.edu.tw **Wed Apr 18 14:07:21 2007**
Return-Path: <lctseng@chbsd.cs.nctu.edu.tw>
X-Original-To: lctseng@nabsd.cs.nctu.edu.tw
Delivered-To: lctseng@nabsd.cs.nctu.edu.tw
Received: from chbsd.cs.nctu.edu.tw (chbsd.csie.nctu.edu.tw [140.113.17.212])
 by nabsd.cs.nctu.edu.tw (Postfix) with ESMTP id 22EC73B4D51
 for <lctseng@nabsd.cs.nctu.edu.tw>; **Wed, 18 Apr 2007 14:07:21 +0800 (CST)**
Received: from chbsd.cs.nctu.edu.tw (localhost [127.0.0.1])
 by chbsd.cs.nctu.edu.tw (8.13.8/8.13.8) with ESMTP id I3I654P3060925
 for <lctseng@nabsd.cs.nctu.edu.tw>; **Wed, 18 Apr 2007 14:05:04 +0800 (CST)**
 (envelope-from lctseng@chbsd.cs.nctu.edu.tw)
Received: (from lctseng@localhost)
 by chbsd.cs.nctu.edu.tw (8.13.8/8.13.8/Submit) id I3I654AY060924
 for lctseng@nabsd.cs.nctu.edu.tw; **Wed, 18 Apr 2007 14:05:04 +0800 (CST)**
 (envelope-from lctseng)
Date: **Wed, 18 Apr 2007 14:05:04 +0800**
From: =?utf-8?B?5aSn5bCP5aeQ?= <lkk-girl@mail.richhome.net>
To: Liang-Chi Tseng <lctseng@nabsd.cs.nctu.edu.tw>
Subject: =?utf-8?B?56yR54uX5aW95Y+v5oCV?=
Message-ID: <20070418060503.GA60903@chbsd.csie.nctu.edu.tw>
MIME-Version: 1.0
Content-Type: text/plain; charset=utf-8
Content-Disposition: inline
Content-Transfer-Encoding: 8bit
User-Agent: **Mutt/1.5.15 (2007-04-06)**
Status: RO
Content-Length: 23
Lines: 1

Newer



Older

Encoding is important!

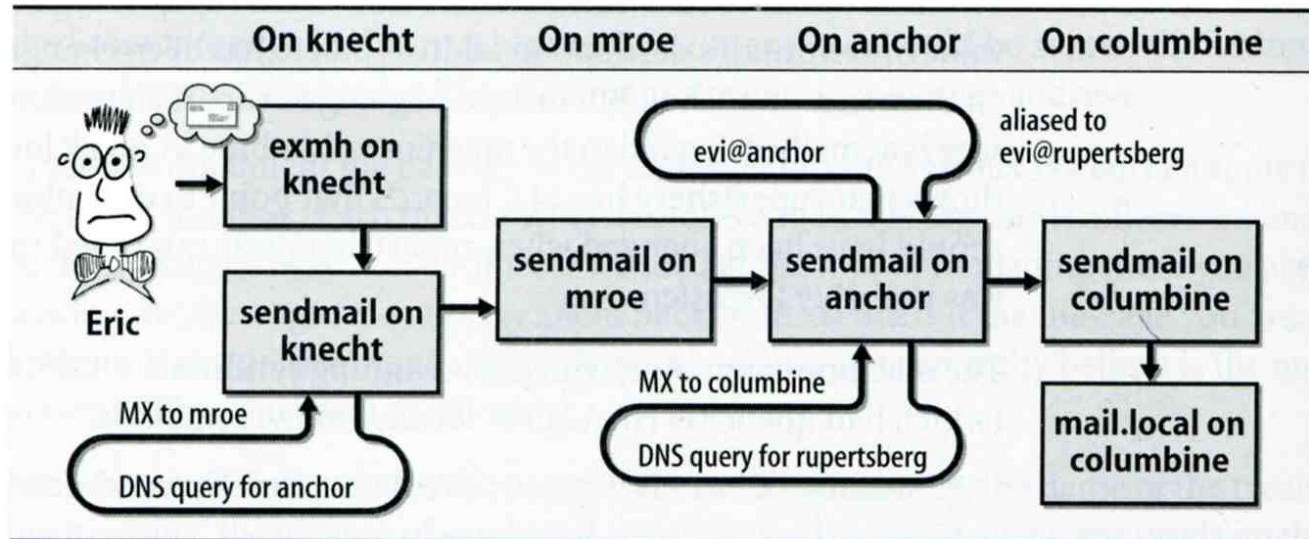
你趕快把牠趕跑好不好？

Mail Headers (3)

□ Example

- User “eric” on “knecht.sendmail.org” sends a email to user “evi” on “anchor.cs.colorado.edu”
 - % dig mx anchor.cs.colorado.edu
 - mroe.cs.colorado.edu

A message from Eric



Mail Headers (4)

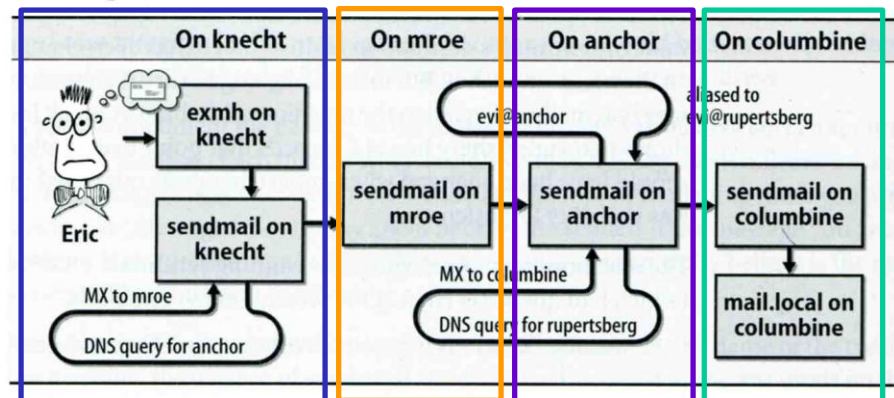
❑ Headers in this example

- From `eric@knecht.sendmail.org`
 - Added by `mail.local` when the mail is put in user's mailbox
 - Used to separate message boundary
- Return-Path: `eric@knecht.sendmail.org`
 - Used to send the error message to this address
 - May be different to the "From" address
- Received: from `knecht.sendmail.org` (localhost [127.0.0.1]) by `knecht.sendmail.org` (8.9.3/8.9.2) with ESMTP id `GAA18984`; Fri 1 Oct 1999 06:04:02 -800 (PST)
 - Every machine that is ever processed this mail will add a "Received" record in top of headers
 - Sending machine
 - Receiving machine
 - Version of sendmail in receiving machine
 - Message unique identifier in receiving machine
 - Date and time

Mail Headers (5)

- Received: from [anchor.cs.Colorado.EDU](mailto:root@anchor.cs.colorado.edu) (root@anchor.cs.colorado.edu [128.138.242.1]) by columbine.cs.colorado.edu (8.9.3/8.9.2) with ESMTP id HAA21741 for evi@rupertsberg.cs.colorado.edu; Fri, 1 Oct 1999 07:04:25 -0700 (MST)
- Received: from [mroe.cs.colorado.edu](mailto:more.cs.colorado.edu) (more.cs.colorado.edu [128.138.243.1]) by anchor.cs.colorado.edu (8.9.3/8.9.2) with ESMTP id HAA26176 for evi@anchor.cs.colorado.edu; Fri, 1 Oct 1999 07:04:24 -0700 (MST)
- Received: from knecht.sendmail.org (knecht.sendmail.org [209.31.233.160]) by mroe.cs.colorado.edu (8.9.3/8.9.2) with ESMTP id HAA09899 fro evi@anchor.cs.colorado.edu; Fri, 1 Oct 1999 07:04:23 -700 (MST)
- Received: from knecht.sendmail.org (localhost [127.0.0.1]) by knecht.sendmail.org (8.9.3/8.9.2) with ESMTP id GAA18984; Fri 1 Oct 1999 06:04:02 -800 (PST)

A message from Eric



Mail Headers (6)

- Message-Id: <199910011404.GAA18984@knecht.sendmail.org>
 - Add by sender's MTA
- X-Mailer: exmh version 2.0.2 2/24/98
 - MUA
 - Non-standard header information
- To: Evi Nemeth <evi@anchor.cs.colorado.edu>
- Subject: Re: hi
- Date: Fri, 1 Oct 1999 06:04:02 -800

Mail System Architecture

❑ Components in a mail system architecture

- Mail servers for incoming and outgoing mails
- Mail home
- IMAP or POP to integrate PC and remote clients

❑ Simplest architecture

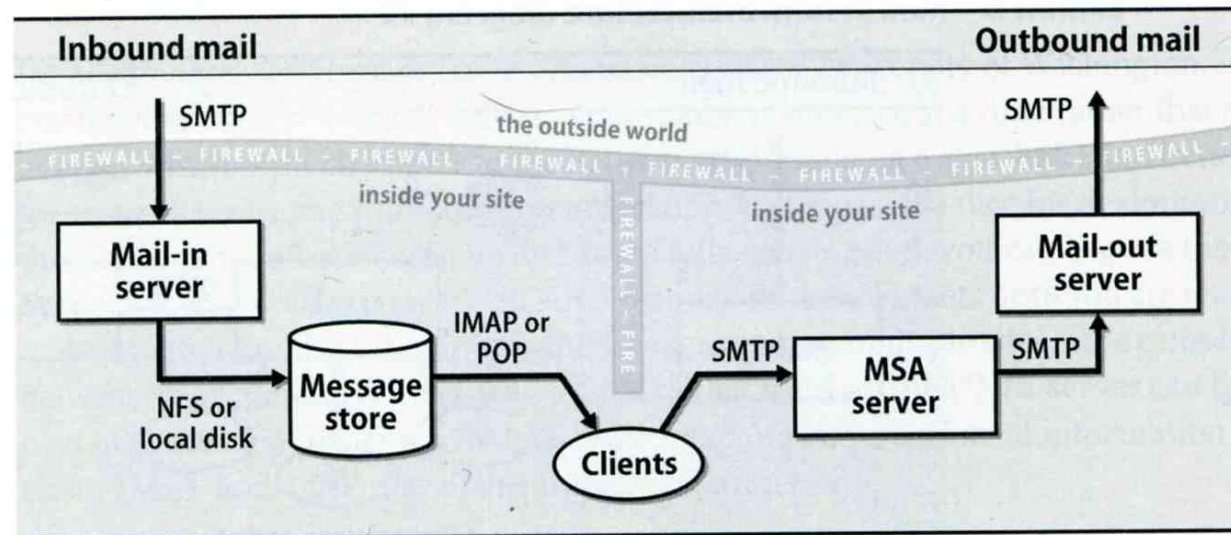
- Only one machine
 - This machine has sendmail to let you send and receive mail
 - This machine is also the mailbox home
 - This machine also provides IMAP or POP to let you download mail from PC

Mail System Architecture – Scalable architecture for medium sites

❑ Centralize

- At least one machine for incoming message and
 - Mail home can be the same host or another one
- At least one machine for outgoing message
 - Each host run MSA and forward mail to the same mail-out server or send the mail directly

Mail system architecture



Mail Alias

❑ Several mechanisms to define aliases:

- Traditional method: in files
- Traditional method with NIS
- LDAP (Light-weight Directory Access Protocol)

❑ When the sendmail wants to resolve name

- File-based method
 - sendmail looks up files to resolve it by itself
- LDAP-based method
 - sendmail call LDAP server to resolve the name and return the results

Mail Alias

– Traditional aliasing mechanism (1)

❑ Aliases can be defined in three places

- In MUA's configuration file
 - Read by MUA and expand the alias before injecting the message into the mail system
- In the system-wide /etc/mail/aliases file
 - Read by MTA
 - The path to the system-wide alias file can be specified in sendmail's configuration file
- In user's forwarding file, ~/.forward
 - Read by MTA after system-wide alias file
 - forward(5)

Mail Alias

– Traditional aliasing mechanism (2)

❑ The format of an entry in aliases file

1. Local-name: recipient1,recipient2,...

• Ex:

➤ admin: lctseng,yench

➤ lctseng: lctseng@nasa.cs.nctu.edu.tw

2. Local-name: :include:another-file

• Ex:

➤ bsdTA: :include:**/usr/local/mail/bsdTA**

Contents of bsdTA

```
lctseng
yench
chchang2222
hmwang
```

Mail Alias

– Traditional aliasing mechanism (3)

3. Local-name: absolute-path-file
 - Mails will be appended to this file
 - Ex:
 - complaints: /dev/null
 - troubles: trouble_admin,trouble_log
 - trouble_admin: :include:/usr/local/mail/troadm
 - trouble_log: /usr/local/mail/logs/troublemail

4. Local-name: "|program-path"
 - Route mail to stdin of program
 - Ex:
 - autoftp: "|/usr/local/bin/ftpserver"

Mail Alias

– Traditional aliasing mechanism (4)

❑ The hashed aliases DB

- `/etc/mail/aliases` is the plaintext aliases information
- `/etc/mail/aliases.db` is the hashed version for efficiency
- Use “newaliases” command to rebuild the hashed version when you change the aliases file

Mail Alias

– Traditional aliasing mechanism (5)

❑ User maintainable forwarding file

- In ~/.forward
- Format: comma-separated
- Ex:
 - "|/usr/local/bin/procmail"
 - lctseng@gmail.com
 - ~/mail_log, lctseng@gmail.com, lctseng@other.domain
- Must be owned by user and writable only to user
 - The path to .forward file should be writable only to user

Mail Alias

– Traditional aliasing mechanism (6)

❑ Alias must

- postmaster and MAILER-DAEMON
 - Mail system maintainer
- bin, sys, daemon, nobody, ...
 - System accounts (root)
- root
 - forward root mail to the administrator (.forward)

```
MAILER-DAEMON: postmaster  
postmaster: root  
bin:      root  
bind:    root  
daemon:  root  
games:   root  
kmem:    root  
mailnull: postmaster  
nobody:  root  
operator: root  
...
```

vacation(1)

□ E-mail auto-responder

- returns a message, `~/.vacation.msg` by default
- `~/.vacation.db`
 - default database file for `db(3)`
- `~/.vacation.{dir,pag}`
 - default database file for `dbm(3)`
- `~/.vacation.msg`
 - default message to send

□ Use with `forward(5)`

- `|/usr/bin/vacation <login name>`
 - `"|/usr/bin/vacation lctseng"`