



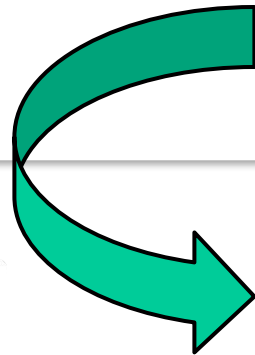
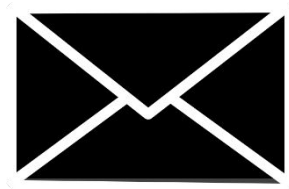
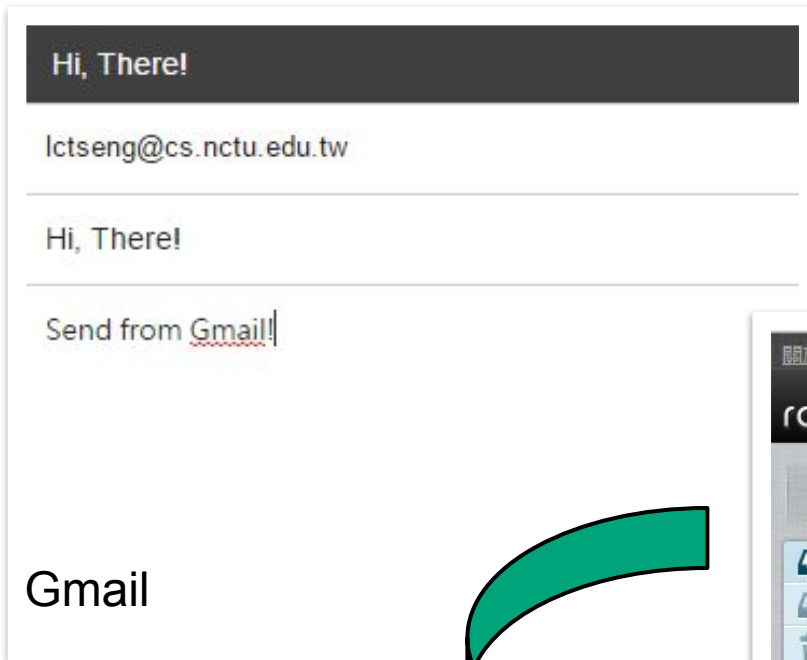
# Mail System

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chenshh

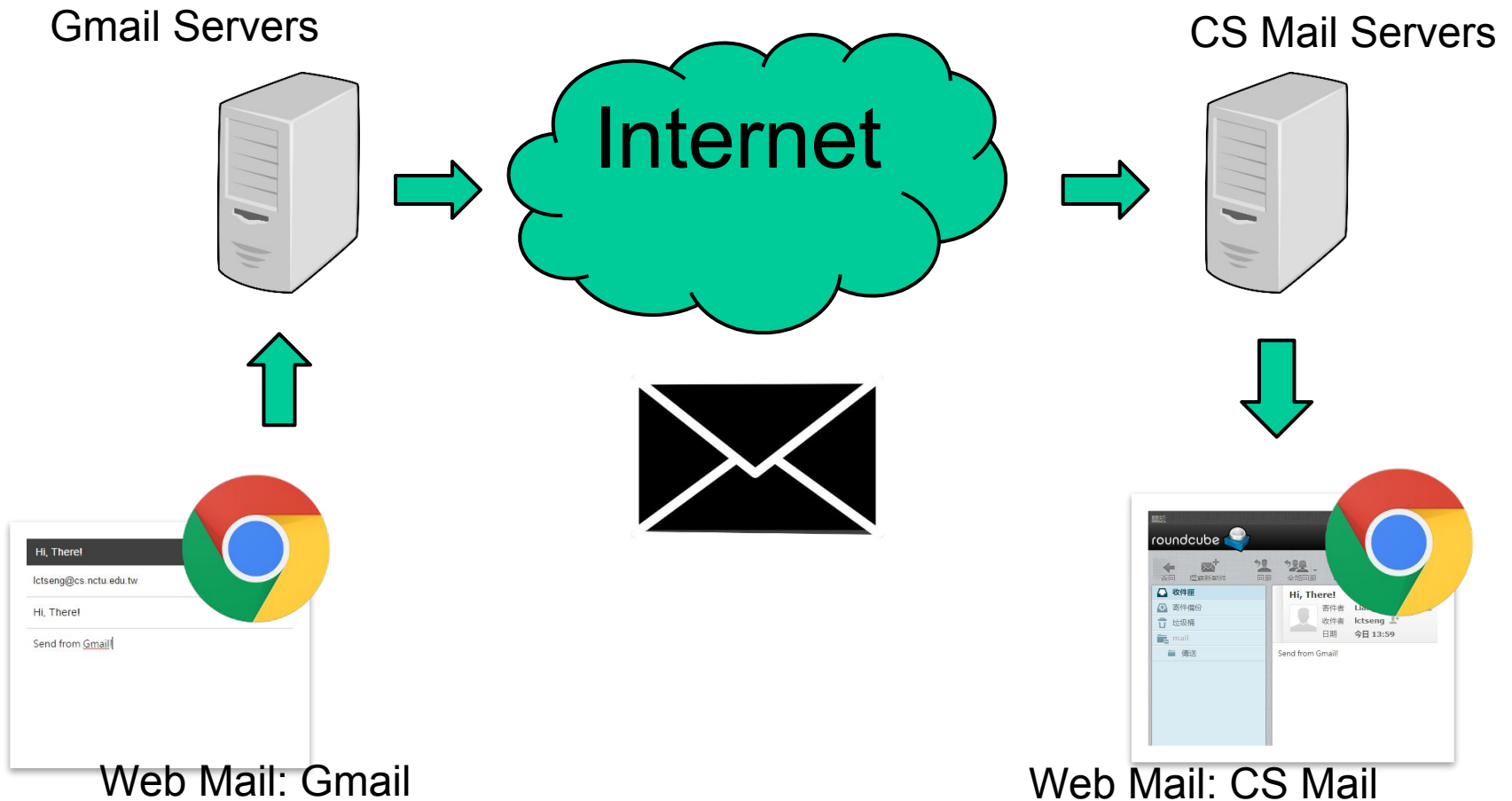
# Mail System

- What behinds the scene when you send an email?



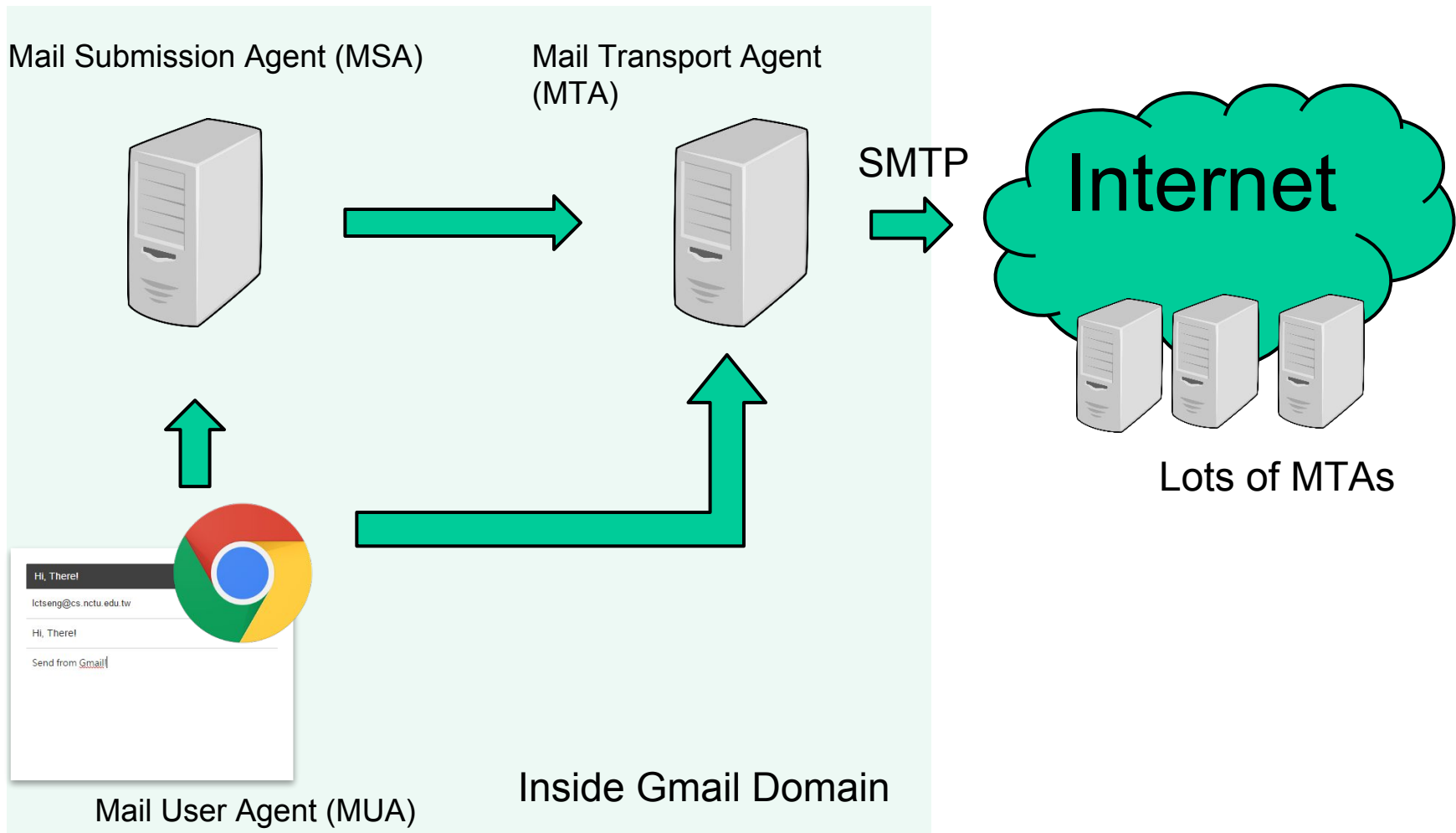
# Mail System

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



# Mail System

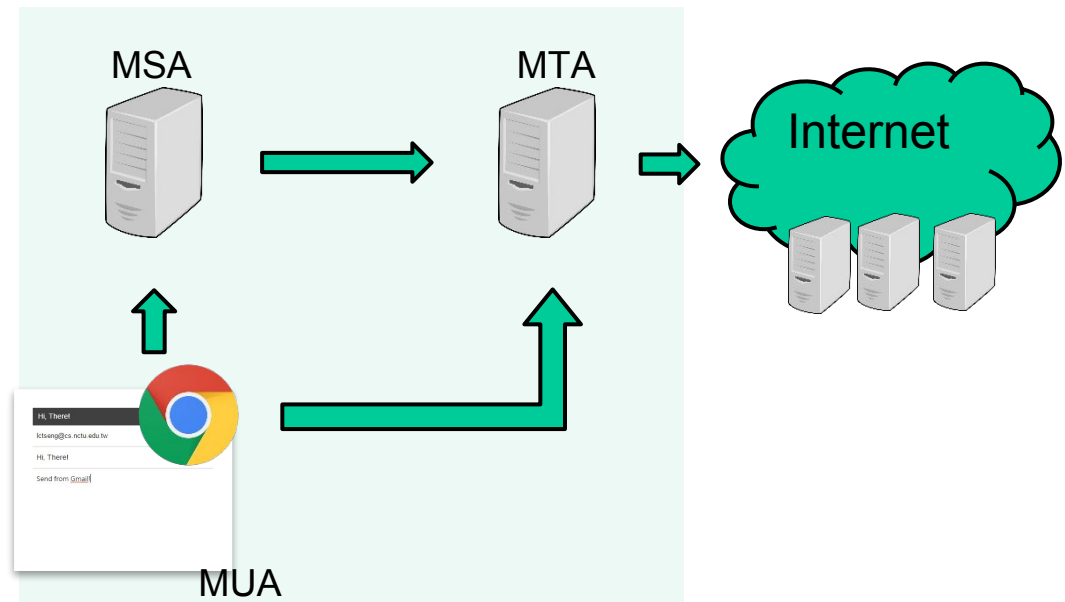
- More detailed view (outgoing, for illustration only)



# Mail System

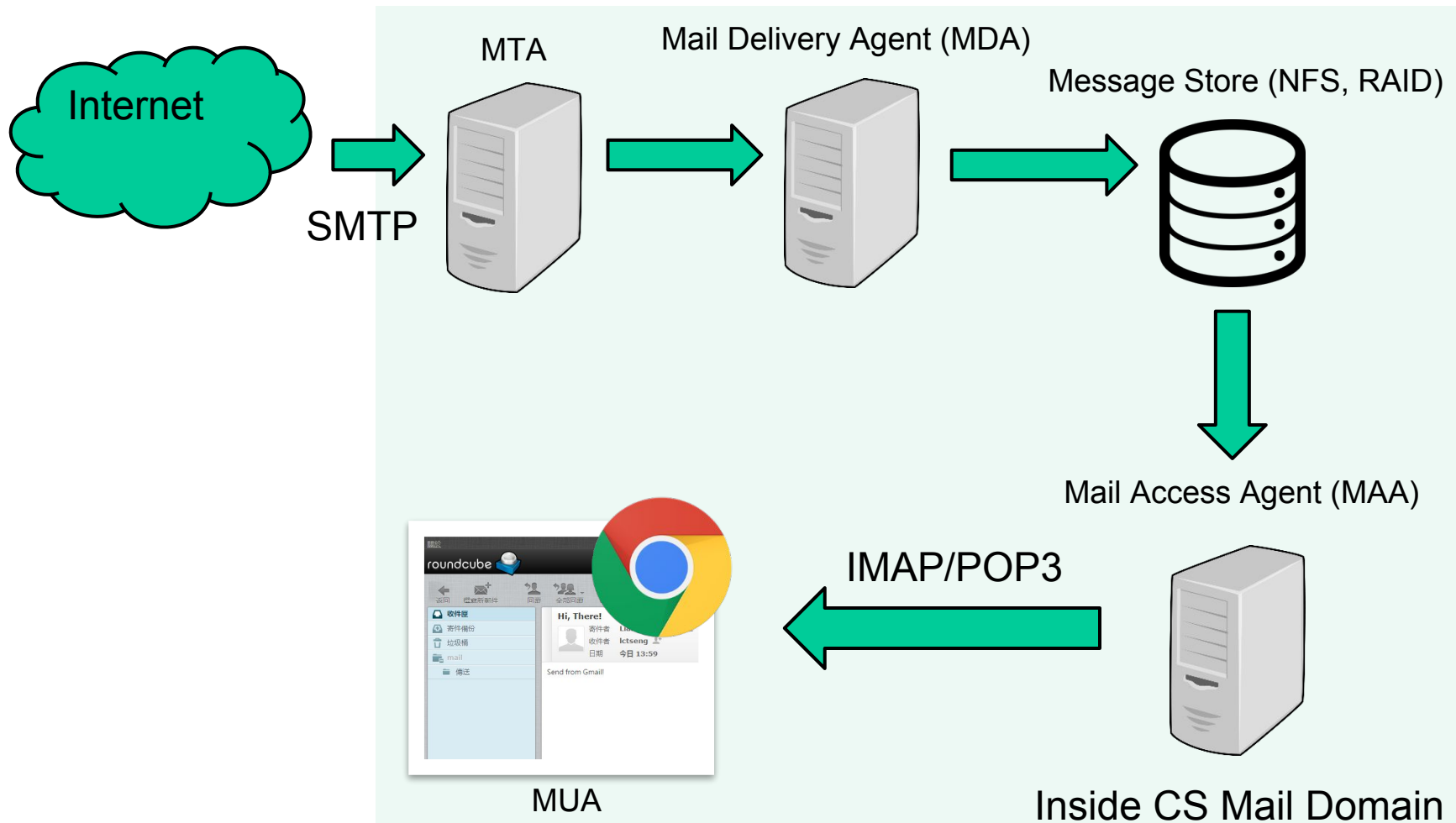
## □ More detailed view (outgoing, for illustration only)

- 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



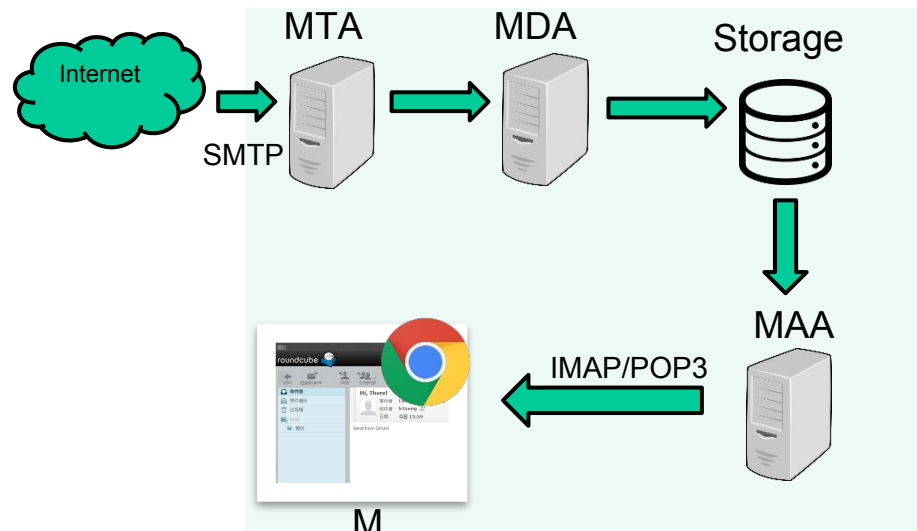
# Mail System

- 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

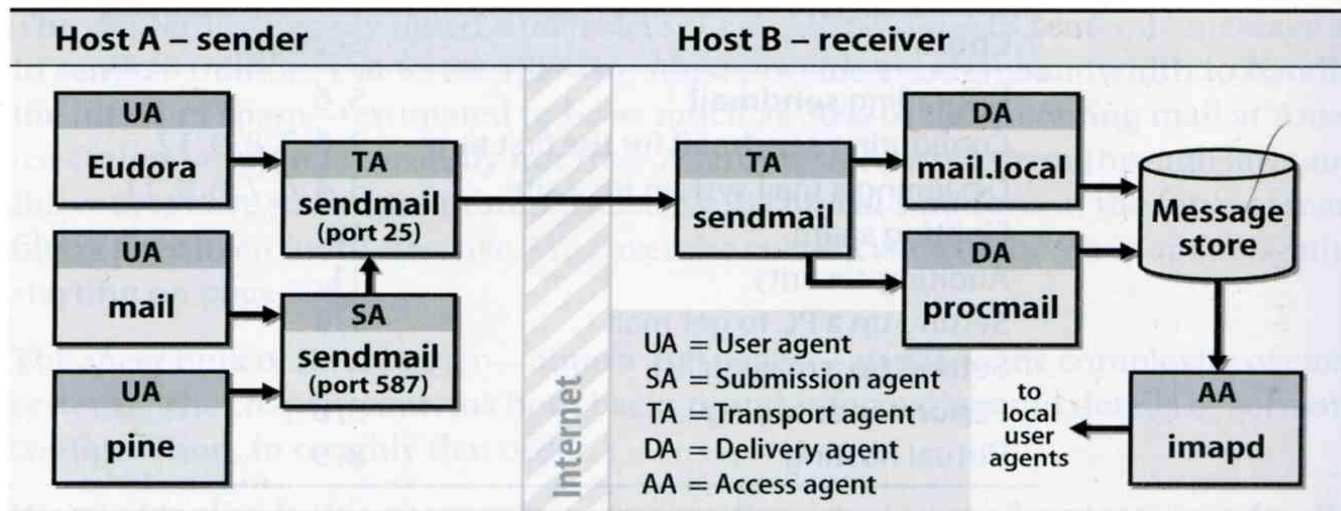


# Mail System

## 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

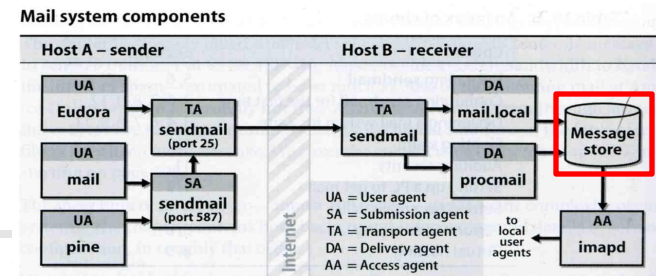
## Mail system components





# 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)

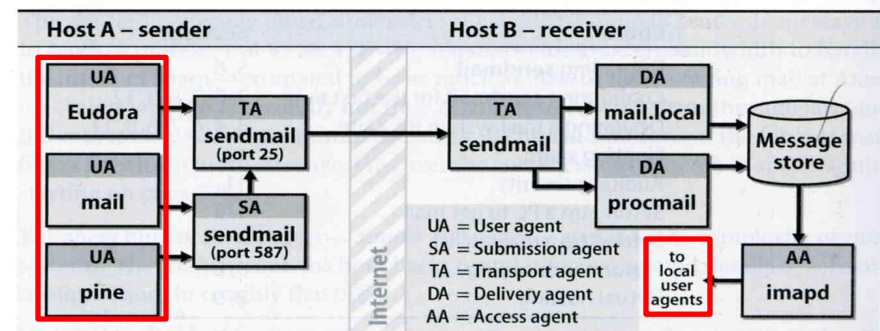
### □ Help user read and compose mails

- 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.	-	-	✓	✓	✓	✓

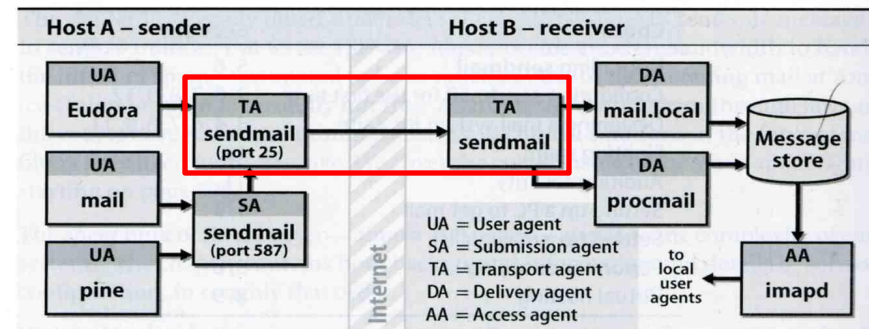
# Mail System

## – 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

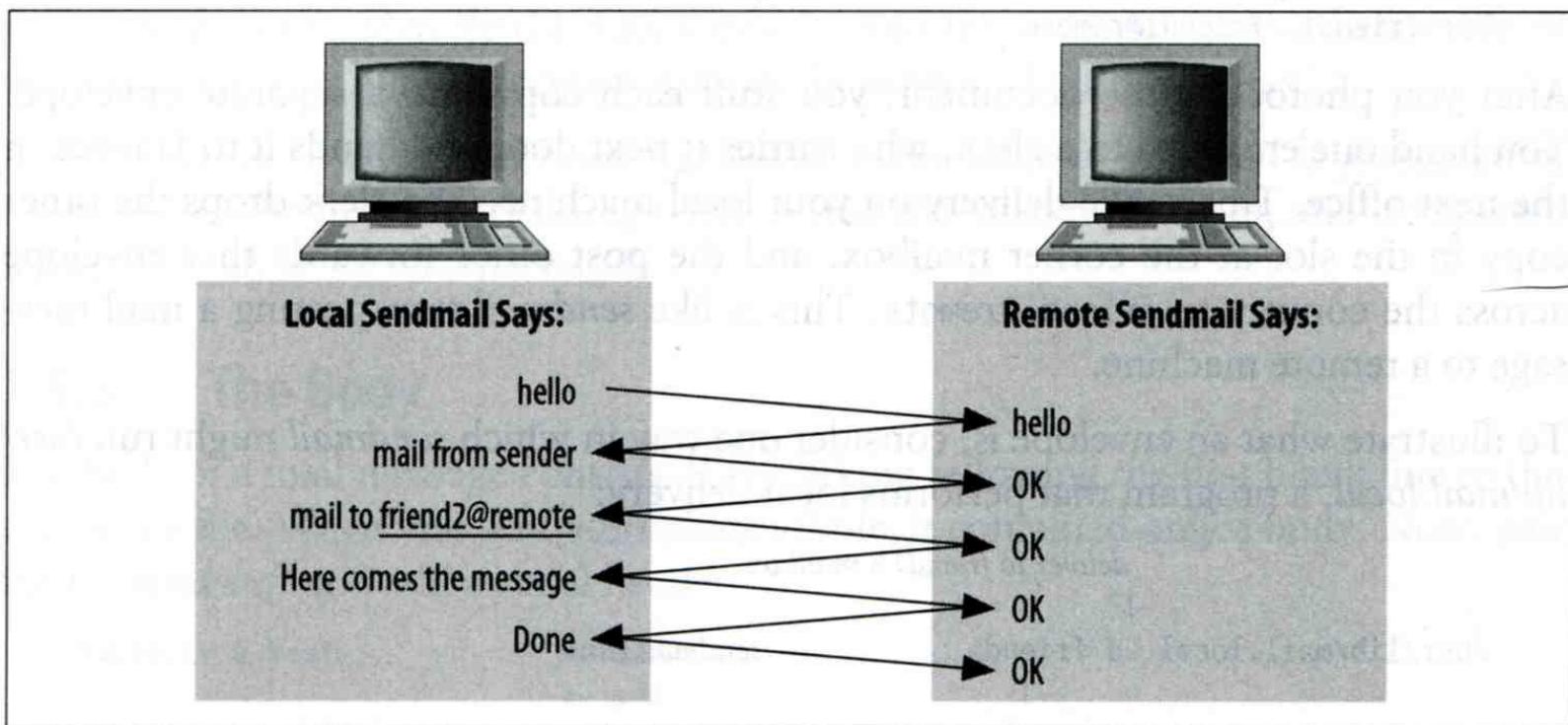


Figure 1-2. A simplified conversation

# 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: letseng@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!



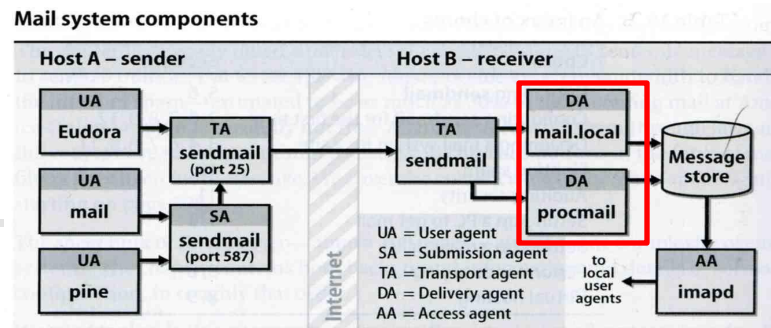


# Mail System

## – 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>

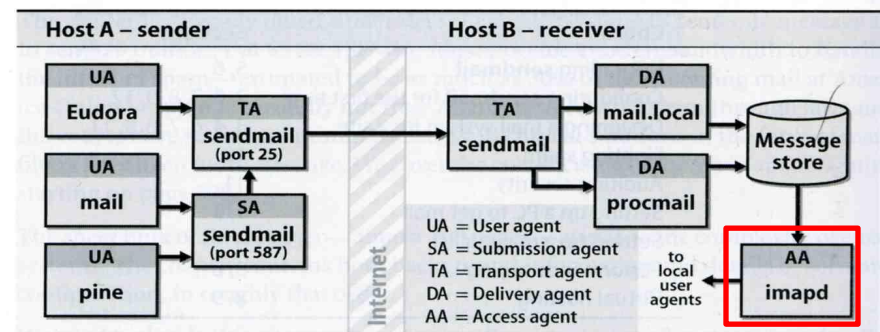


# Mail System

## – 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

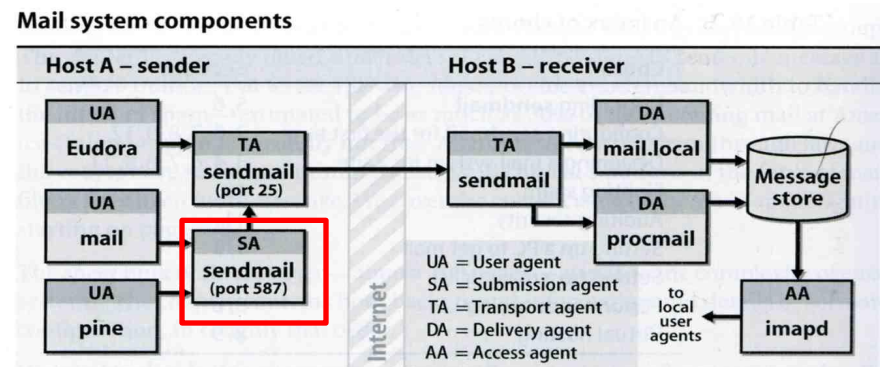


# Mail System

## – 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)

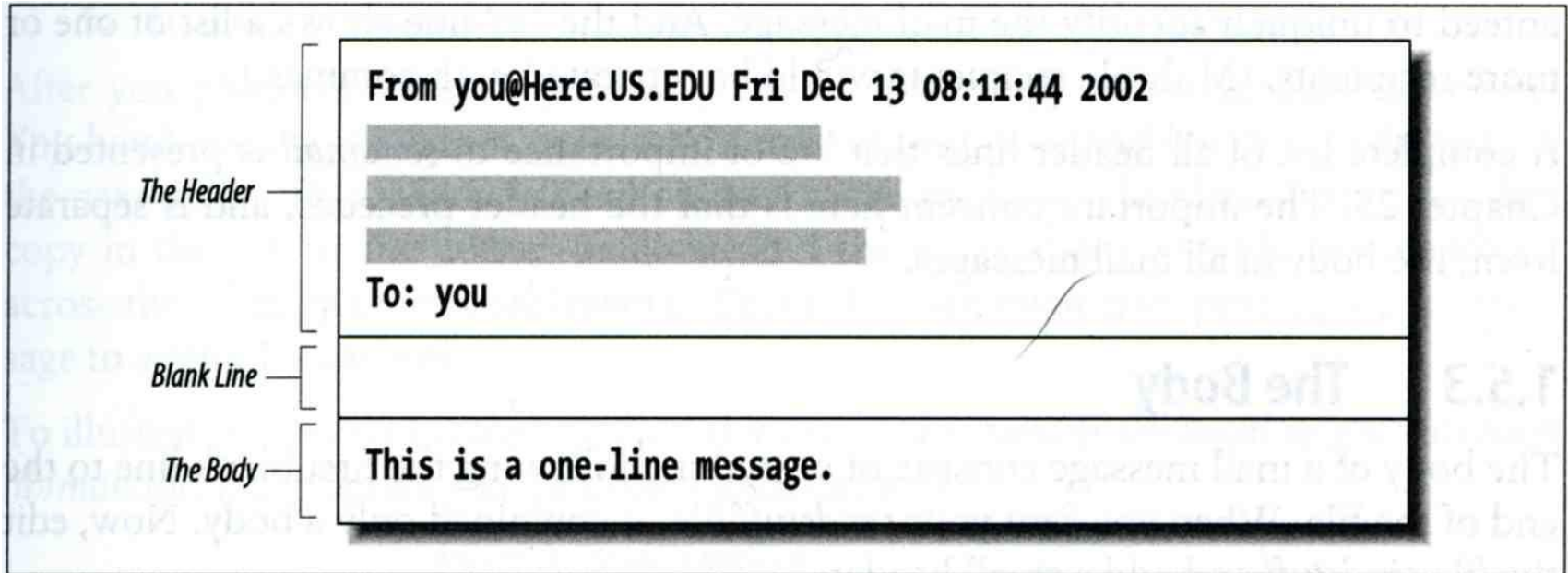


Figure 1-1. Every mail message is composed of a header and a body

# 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?= <lkg-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



Encoding is important!

Newer



Older

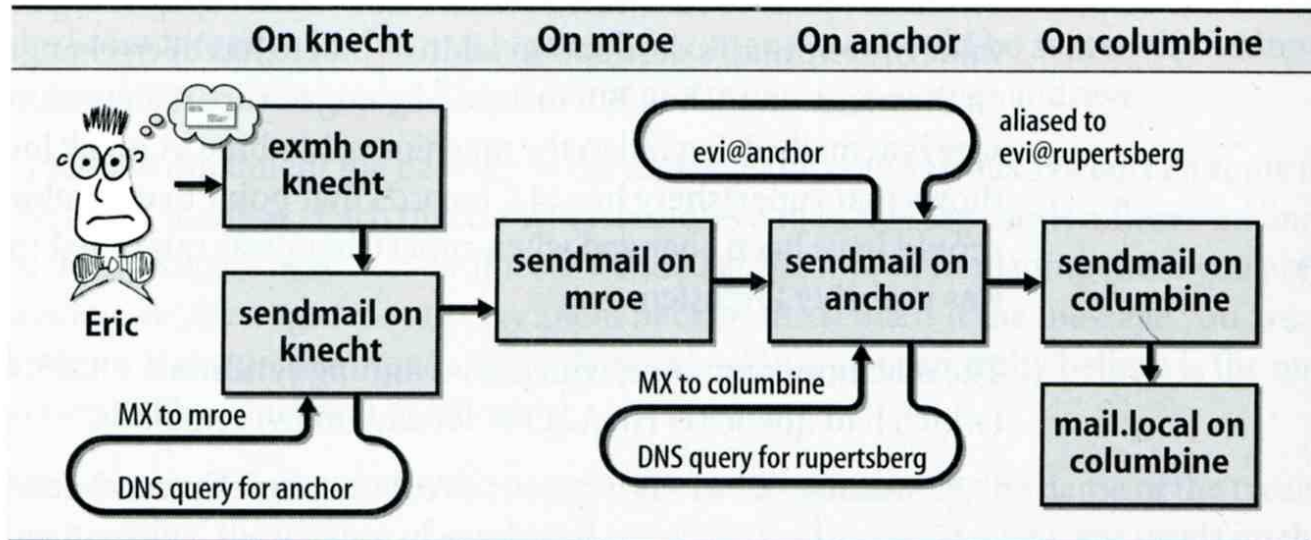
你趕快把牠趕跑好不好？

# 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)

---

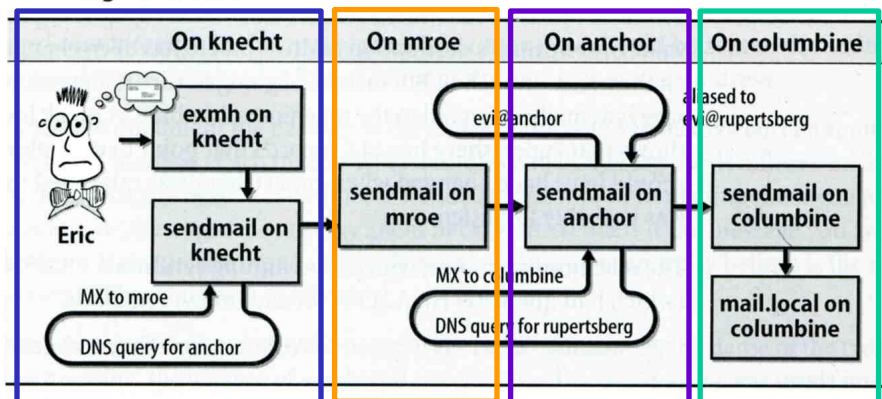
## ❑ Headers in this example

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

---

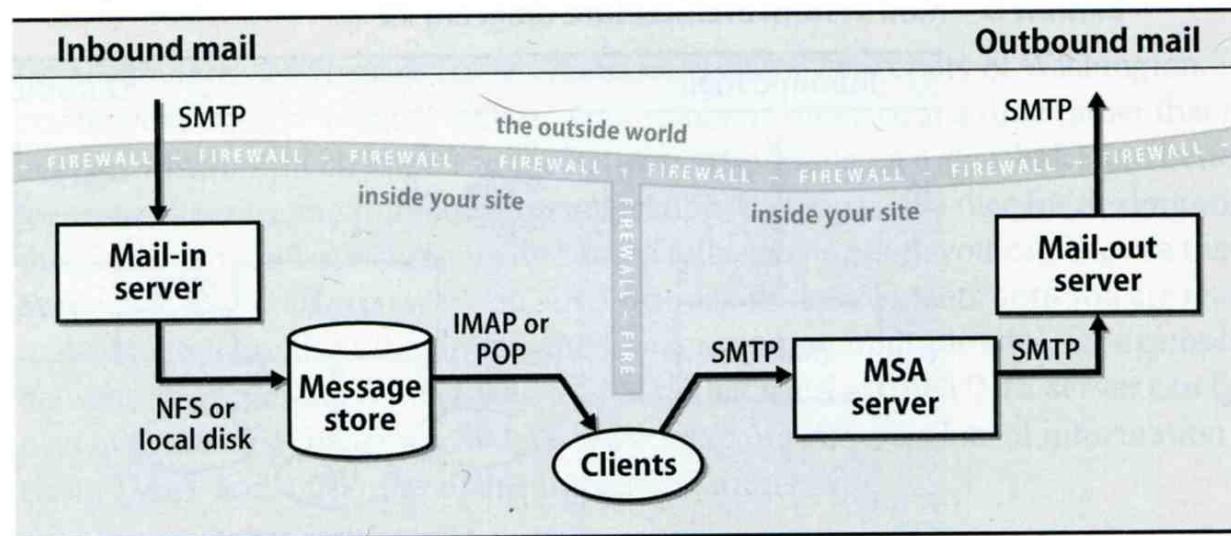
- ❑ Components in a mail system architecture
  - Mail servers for incoming and outgoing mails
  - Mail home
  - IMAP or POP to integrate PC and remote clients
  
- ❑ Simplest architecture
  - Only one machine
    - This machine has sendmail to let you send and receive mail
    - This machine is also 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: newline-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"`