E-Mail System

Components of an E-Mail (1)

- Three major components
  - The envelope
    - Invisible to users
    - Determine where the message should be delivered, or to whom it should be returned
  - The headers
    - Information about the messages, defined in RFC2822
      - Date, From, To, Content-Type, charset
      - Content-Length, MessageID, …
      - No checking consistent “To” in envelope and header
  - The message body
    - Plain text only
    - Various MIME contents (attachments)
      - 7bit, quoted-printable, base64
      - 8bit, binary

Components of an E-Mail (2)

- You can really see …
  - Headers, which can be forged, altered, etc.
  - Body

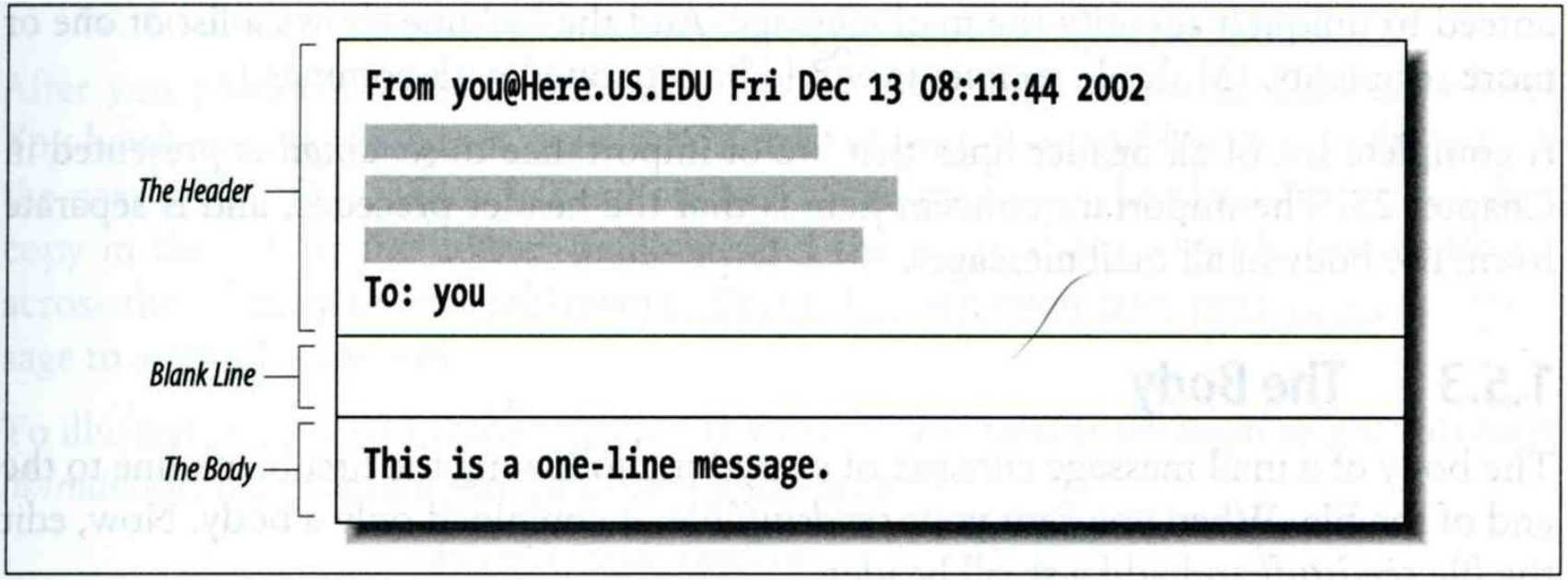
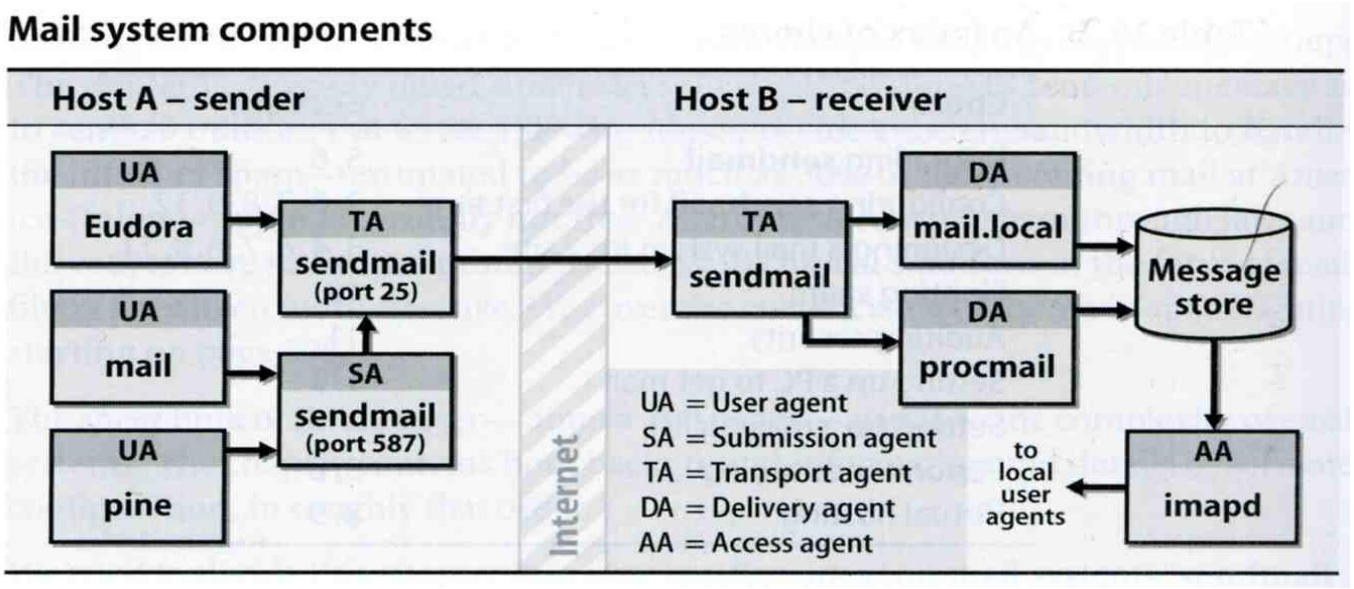


Figure 1-1. Every mail message is composed of a header and a body

Mail System

❑Major components

- Mail User Agent (MUA)
  - Help user read and compose mails
- Submission Agent (SA)
  - Route mails to local MTA
- Mail Transport Agent (MTA)
  - Route mails among machines
- Delivery Agent (DA)
  - Place mails in users' mail boxes
- Access Agent (AA)
  - Connects the user agent to the mail box using POP3 or IMAP protocols



Mail System – The User Agent (1)

- Help user read and compose mails
  - UA must know mail format
    - Originally: Text only
    - Now: MIME

※ MIME (Multipurpose Internet Mail Extensions)

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

Mail System – The User Agent (2)

- Popular Mail User Agents

User Agent	System Config.	User Config.	MIME	POP	IMAP	SMTP
mail	mail.rc	.mailrc				
mutt	/etc/Muttrc	.muttrc	✓	✓	✓	✓
Netscape	-	-	✓	✓	✓	✓
Outlook Ep.	-	-	✓	✓	✓	✓
MS Outlook	-	-	✓	✓	✓	✓
Thunderbird	-	-	✓	✓	✓	✓
In Smartphones	-	-	✓	✓	✓	✓

Mail System – The Submission Agent

- Route mails to local MTA
  - Typical works that a MTA must do:
    - Ensuring that all hostname are fully qualified
    - Modifying headers
      - MessageID
      - Date
      - DomainKeys/DKIM
    - Logging errors
    - ...
  - RFC2476 introduces the idea of splitting MTA
    - Let SA to share the load

Mail System – The Transport Agent (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
    - ESMTP (Extended SMTP)
      - RFC 2821 → … → 5321 (2008)
  - Popular transport agents
    - sendmail http://www.sendmail.org/
      - sendmail X → MeTA1
    - Postfix http://www.postfix.org/
    - exim, qmail, …

Mail System – The Transport Agent (2)

- Conversation between MTAs
  - Threat of eavesdropping

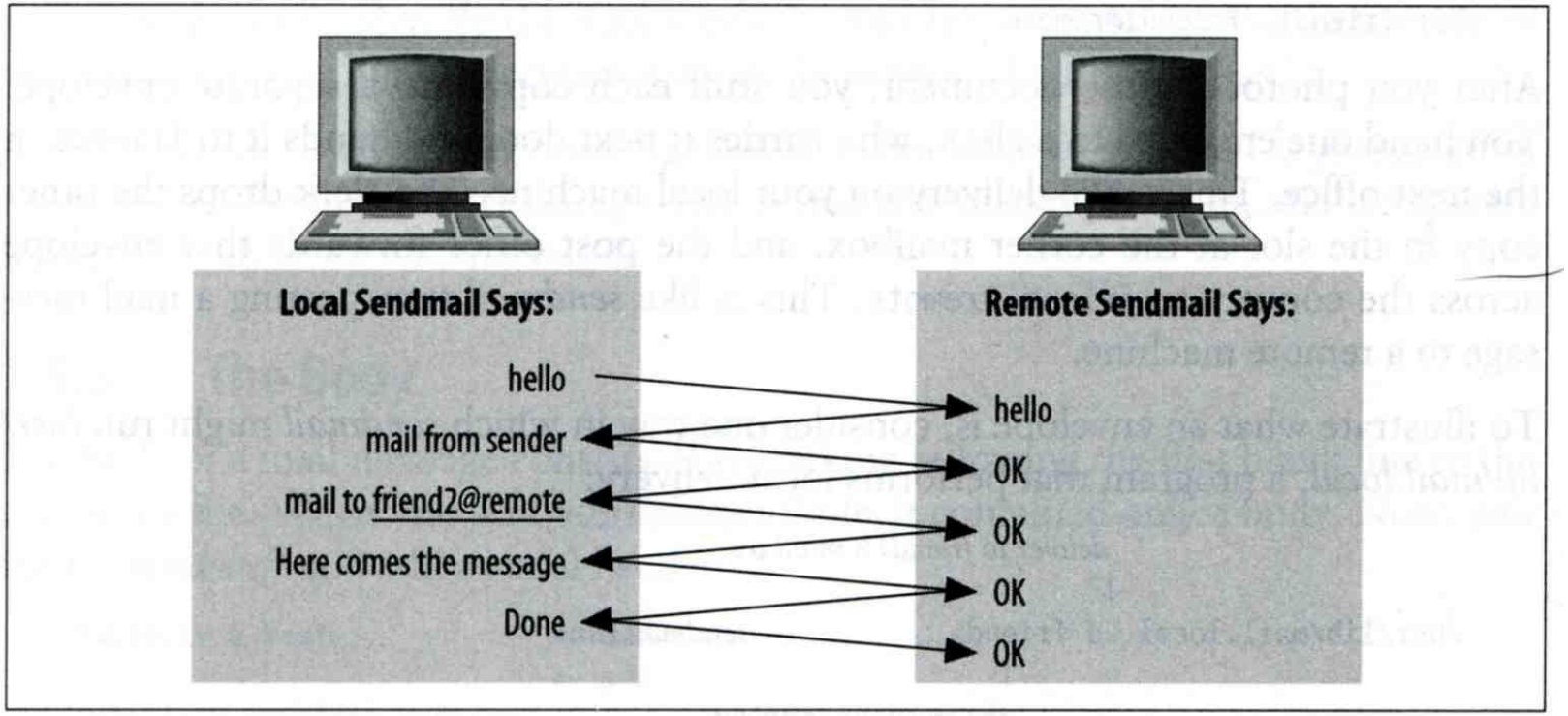


Figure 1-2. A simplified conversation

Mail System – The Transport Agent (3)

- Protocol: SMTP

```
$ telnet csmailgate 25
Trying 140.113.235.103...
Connected to csmailgate.
Escape character is '^]'.
220 csmailgate.cs.nctu.edu.tw ESMTP Postfix
ehlo bsd5.cs.nctu.edu.tw
250-csmailgate.cs.nctu.edu.tw
250-PIPELINING
250-SIZE 204800000
250-VRFY
250-ETRN
250-ENHANCEDSTATUSCODES
250-8BITMIME
250 DSN
```

```
mail from: <liuyh@cs.nctu.edu.tw>
250 2.1.0 Ok
rcpt to: <liuyh@cs.nctu.edu.tw>
250 2.1.5 Ok
data
354 End data with <CR><LF>.<CR><LF>
From: haha <devnull@cs.nctu.edu.tw>
To: admin@hinet.net

hehe... I spammed you!
.
250 2.0.0 Ok: queued as 81BD4FB4
quit
221 2.0.0 Bye
Connection closed by foreign host.
```

```
From: haha <devnull@cs.nctu.edu.tw>
To: admin@hinet.net
Message-Id: <20120501070002.81BD4FB4@csmailgate.cs.nctu.edu.tw>
Date: Tue,  1 May 2012 14:59:53 +0800 (CST)

hehe... I spammed you!
```

Mail System – The Delivery Agent

- Place mails in users' mailboxes
  - Accept mail from MTA and deliver the mail to the local recipients
  - Type of recipients
    - User
    - Program
      - procmail
      - bogofilter
  - procmail
    - Do something between mail coming in and stored in mail box
    - https://help.cs.nctu.edu.tw/help/index.php/設定_-_郵件過濾設定

Mail System – The Access Agent

- Help user download mail from server
  - Protocols
    - IMAP (Internet Message Access Protocol)
    - POP3 (Post Office Protocol – Version 3)

Mail Addressing – Domain (1)

- Two kinds of email addresses:
  - Route based address (obsolete)
    - 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: liuyh@nasa.cs.nctu.edu.tw

Mail Addressing – Domain (2)

- Where to send the mail?
  - When you want to send a mail to liuyh@cs.nctu.edu.tw, the MTA will:
    - First, lookup up the mail exchanger of "cs.nctu.edu.tw"

```
$ dig mx cs.nctu.edu.tw

;; ANSWER SECTION:
cs.nctu.edu.tw.     3600    IN      MX      5 csmx2.cs.nctu.edu.tw.
cs.nctu.edu.tw.     3600    IN      MX      10 csmx3.cs.nctu.edu.tw.
cs.nctu.edu.tw.     3600    IN      MX      5 csmx1.cs.nctu.edu.tw.
```

      - If there is any servers, try until success from the higher preference one to the lower
      - If no MX records, mail it directly to the host (A record)

Mail Addressing – Domain (3)

- Why using "Mail eXchanger"?
  - We can centralize all the mail tasks to group of servers
  - Multiple mail exchangers make it more robust

Mail Addressing – Alias

- Alias
  - Map a username to something else
    - Be careful of mail looping
- Several mechanisms to define aliases:
  - Traditional method: in files
  - Traditional method with NIS
  - LDAP (Light-weight Directory Access Protocol)
- When the mail server wants to resolve name
  - File-based method
    - look up files to resolve by itself
  - LDAP-based method
    - 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 configuraiton 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 DA
    - The path to the system-wide alias file can be specified in mail server's configuration file
  - In user's forwarding file, ~/.forward
    - Read by DA 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: huanghs,chiahung,liuyh
    - liuyh: liuyh@cs.nctu.edu.tw
    - root: ta

  2. Local-name: :include:filename
  - Ex:
    - ta: :include:/usr/local/mail/TA

Contents of TA

```
chiahung
huanghs
liuyh
changlp
cychao
wangth
pmli
```

Mail Alias – Traditional aliasing mechanism (3)

- The format of an entry in aliases file

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"
  - nahw1: "|/home/nahw1/receive.pl"

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
    - The file read from “:include:” is outside the aliases file

Mail Alias
– Traditional aliasing mechanism (5)

- User maintainable forwarding file
  - In ~/.forward
  - Format: comma-separated
  - Ex:
    - liuyhh@gmail.com
    - \liuyh, liuyhh@gmail.com, liuyhh00@yahoo.com.tw
  - Must be owned by user and with permission of 600
    - The path to .forward file should be writable only to user

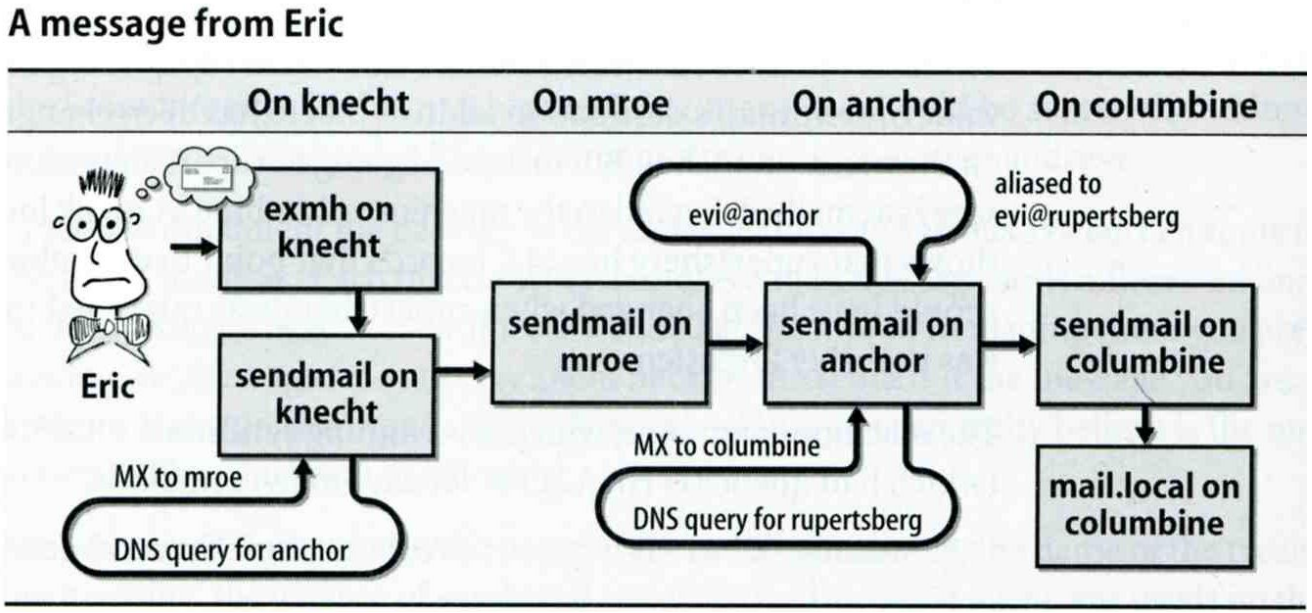
Mail Alias – Traditional aliasing mechanism (6)

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

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

Mail Transport Example

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



Mail Headers (1)

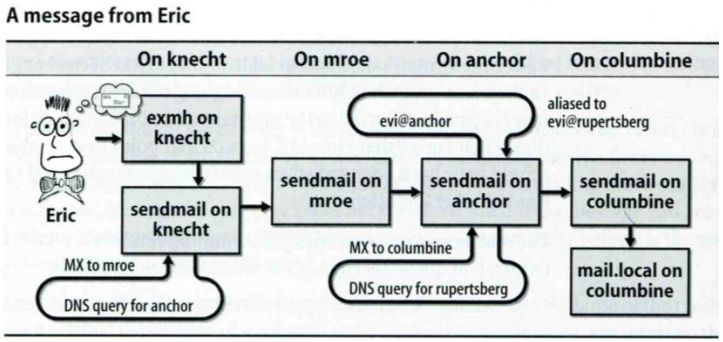
- Defined by RFC2822
  - Mail reader will hide some uninteresting header information

```
Date: Wed, 18 Apr 2007 14:05:04 +0800
From: 大小姐 <lkkg-girl@mail.richhome.net>
Subject: 笑狗好可怕
To: Yung-Hsiang Liu <liuyh@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 chwong@chbsd.cs.nctu.edu.tw  Wed Apr 18 14:07:21 2007
Return-Path: <chwong@chbsd.cs.nctu.edu.tw>
X-Original-To: liuyh@nasa.cs.nctu.edu.tw
Delivered-To: liuyh@nasa.cs.nctu.edu.tw
Received: from chbsd.cs.nctu.edu.tw (chbsd.csie.nctu.edu.tw [140.113.17.212])
        by nasa.cs.nctu.edu.tw (Postfix) with ESMTP id 22EC73B4D51
        for <chwong@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 l3I654P3060925
        for <chwong@nabsd.cs.nctu.edu.tw>; Wed, 18 Apr 2007 14:05:04 +0800 (CST)
        (envelope-from chwong@chbsd.cs.nctu.edu.tw)
Received: (from chwong@localhost)
        by chbsd.cs.nctu.edu.tw (8.13.8/8.13.8/Submit) id l3I654AY060924
        for chwong@nabsd.cs.nctu.edu.tw; Wed, 18 Apr 2007 14:05:04 +0800 (CST)
        (envelope-from chwong)
Date: Wed, 18 Apr 2007 14:05:04 +0800
From: =?utf-8?B?5aSn5bCP5aeQ?= <lkkg-girl@mail.richhome.net>
To: Yung-Hsiang Liu <liuyh@nasa.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

你趕快把牠趕跑好不好？
```

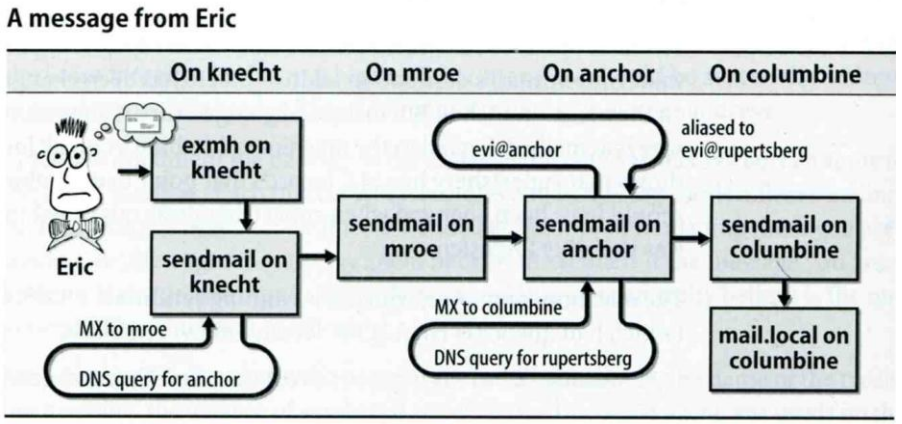
Mail Headers (3)



- Headers in the 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
    - The envelope "mail from"
    - Used to send the error message to this address
    - May be different to the "From" address
  - Delivered-To: evi@rupertsberg
    - Final envelope "rcpt to"
  - 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、Mail server software in receiving machine Unique queue identifier of mail server in receiving machine、Date and time

Mail Headers (4)

- Received: from 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 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 more.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)



Mail Headers (5)

- 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 Storage

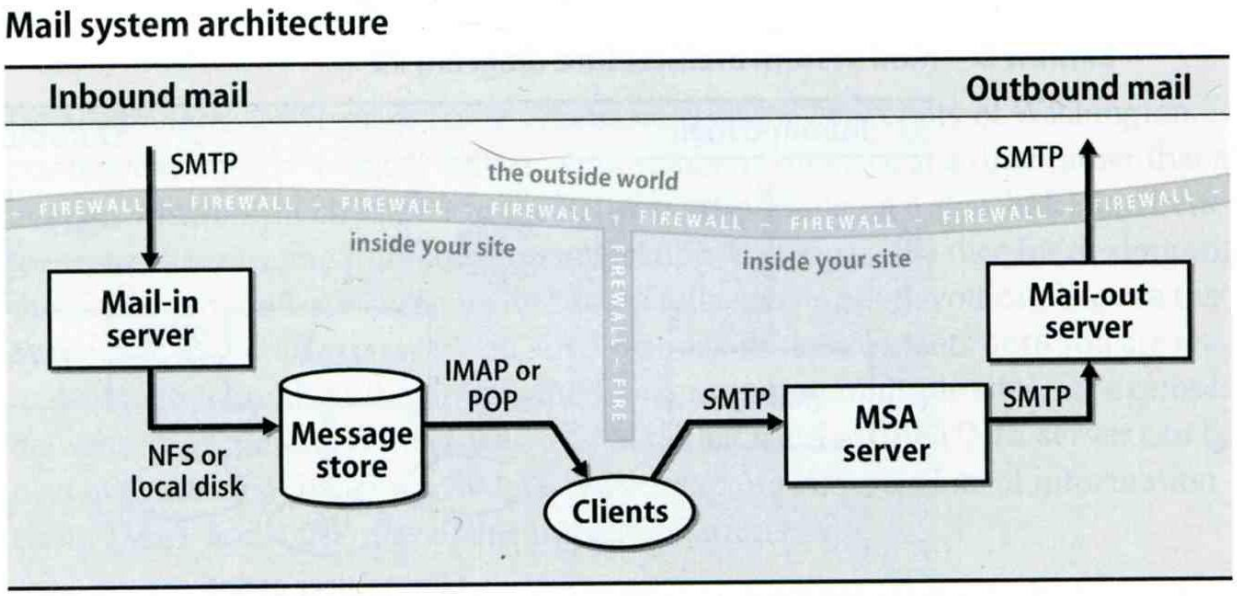
- The place on the local machine where email is stored
  - Usually the directory: /var/mail or /var/spool/mail
    - Users' mails are stored in files named with each user's login name
      - Eg. /var/mail/liuyh
    - Permission "775" and root:mail as the owner and group owner
      - drwxrwxr-x 2 root mail 512 Dec 16 15:51 mail/
  - Using database
    - When the organization is large or for ISP with millions of customers
    - Easy to search, categorize

Mail System Architecture

- Simplest architecture
  - Only one machine
    - Has MTA to let you send and receive mail
    - Provides storage for mailboxes
    - Provides IMAP or POP3 to let you download mail from PC
- Components in a mail system architecture
  - Mail servers for incoming and/or outgoing mails
  - Storage for mailboxes
  - IMAP or POP3 to integrate PC and remote clients
    - The issue of file locking

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



To, Cc, and Bcc

- You should always make sure you e-mail the right people
  - The **To field** is for people that the message directly affects, and that you require action from.
  - The **Cc (or carbon copy) field** is for people you want to know about the message, but are not directly involved.
  - The **Bcc field (Blind Carbon Copy)** is used when you want other people to receive the message, but you don't want the other recipients to know they got it.
- There are “To” and “Cc,” but not “Bcc” in the email headers.
  - Why “No checking consistent “To” in envelope and header”

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)
  - \liuyh, |/usr/bin/vacation