

Electronic mail

Aka email (Knuth)

History of email (1)

- 1971 Tomlinson's first email
 - introduces the @-symbol
 - piggybacked on FTP
- 1979 UUCP-based email
 - introduces the bang (!)
 - not based on TCP/IP (or NCP)

History of email (2)

- 1982 SMTP specified
- 1983 sendmail released (4.1c BSD)
- 1984 DNS specified
- sendmail knows about
 - @ (ARPANET)
 - ! (UUCP)
 - : (BerkNet)

Survey October 2001 (1)

(Dan Bernstein)

- 401 UNIX (Sendmail)
- 176 Windows (Exchange/IIS)
- 167 UNIX (qmail)
- 57 Windows (Ipswitch IMail)

Survey October 2001 (2) (Dan Bernstein)

- 23 UNIX (smap)
- 15 UNIX (IBM Postfix, formerly VMailer)
- 14 UNIX (Exim)

Survey May 2003 (Thomas Pircher)

- 19169 (35.59%) Sendmail
- 4537 (8.42%) qmail
- 4104 (7.62%) Postfix
- 2812 (5.22%) Microsoft (Exchange/IIS)
- 2464 (4.57%) Exim

Survey October 2004 (SNB)

- 20492 (35.3%) Sendmail
- 12172 (21.0%) Microsoft (Exchange/IIS)
- 6836 (11.8%) Exim
- 4008 (6.9%) iMail
- 3669 (6.3%) qmail
- 3172 (5.5%) Postfix

Email concepts

- Message agents (no RFC)
- Message format (RFC 2822)
- Message transport (RFC 2821)
- Message stores (no RFC)

Message agents

- MUA (Mail User Agent)
- MTA (Mail Transport Agent)
- MDA (Mail Delivery Agent)
- MSA (Mail Submission Agent)
- MAA (Mail Access Agent)
- MRA (Mail Retrieval Agent)

Mail User Agent

- Interface for the email user
 - reads and composes messages
 - mutt, pine, Outlook, Thunderbird, ...
- Often uses SMTP to send mail (→ MSA)
- Often uses IMAP/POP3 to get mail (← MAA)
- May have direct access to message store

Mail Transport Agent

- Transports email across the Internet
 - Uses SMTP as transport protocol
 - sendmail, postfix, qmail, exim
- Often also operates as a Mail Submission Agent
- Makes use of MX records to transport email

Mail Delivery Agent

- Delivers email into the message store (MS)
 - mail, mail.local, rmail, procmail
 - may do filtering, SPAM and virus checking, ...
 - has knowledge about mailbox formats
 - can use global (/var/mail) or user-specific (\$HOME/mbox) space

Mail Submission Agent (1)

- Discussed in RFC 2476
- Injects message into mail system
- Sanitizes message content
 - Envelope domains must be FQDNs
- Often combined with MTA
 - May bind to its own port (587)

Mail Submission Agent (2)

- Can operate locally
 - sendmail (no daemon mode)
 - postdrop
 - without SMTP or with piped SMTP
- May be an MTA-frontend
 - smapd

Mail Access Agent

- Can get message out of Message Store (MS)
- Offers services to access mail to MUA (or MRA)
 - POP3 (Post Office Protocol)
 - IMAP (Internet Message Access Protocol, version 4)

Mail Retrieval Agent

- Program that uses a MAA to collect mail
- Possibly reinjects mail into the mail system
 - fetchmail
 - sendmail ETRN

Mail Agent Relationships

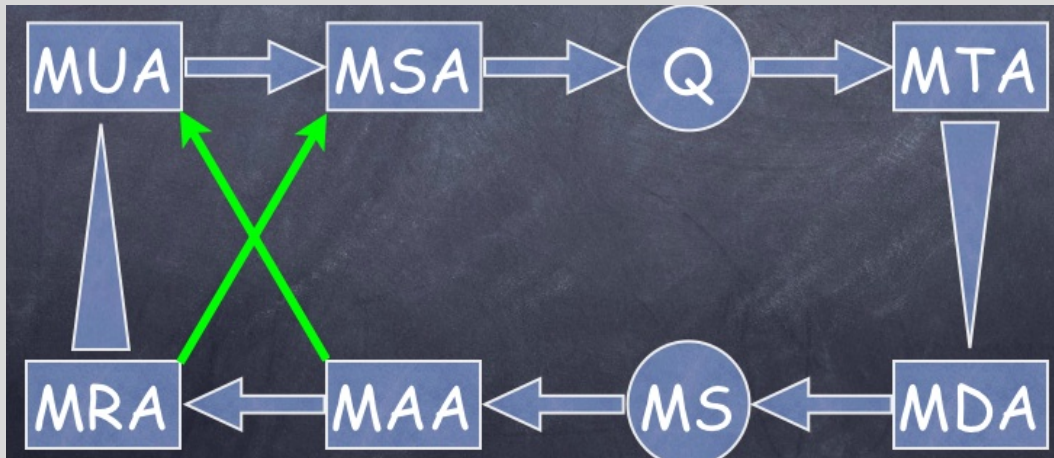


Figure 16.1 Mail Agent Relationships

Securing Email (1)

- Use secure protocols
 - imap (port 143) → imaps (port 993)
 - pop3 (port 110) → pop3s (port 995)
 - smtp (port 25) → smtps, ssmtp (port 465)?

Securing Email (2)

- SMTP improvements
 - Authenticated SMTP
 - ★ AUTH extension
 - ★ based on SASL
 - STARTTLS extension

Securing Email (3)

- Use MUA-based encryption and authentication
 - PGP (Pretty Good Privacy)
 - ★ Inline or PGP/MIME
 - GPG (GNU Privacy Guard)
 - S/MIME

Message format

- RFC 2822
- Headers, empty line, body
- Only 7-bit US-ASCII (1-127) allowed
 - MIME extends this to possibly 8-bit
- Lines are delimited by <CR><LF>
- Lines should be no longer than 78 characters

Message (ABNF)

- message = (fields / obs-fields) CRLF body
- body = $^{*}(*998\text{text CRLF}) *998\text{text}$
- Mathematical isomorphism
 - $\text{text}^{*+} \cong (\text{text} \cup \{\text{CRLF}\})^{*}$
- CRLF is delimiter, not terminator

Header format

- <Field name>:<Field body>
- <Field name>
 - printable US-ASCII (33-126)
 - except “:” (58)
- <Field body>
 - US-ASCII (1-127) except CR(13) and LF(10)

Some important headers

- From:<originator mailbox>
- Sender:<sender mailbox>
- To:<recipient mailbox>
- Message-Id:<unique message identification>
- Received:<registration of message transport>

Message transport

- SMTP (RFC 2821)
 - Uses Network Virtual Terminal (NVT) presentation layer from RFC 854 (TELNET)
- Mail objects
 - content (in “message format”)
 - envelope (SMTP parameters)

Normal (E)SMTP session

- “EHLO” (greeting, option negotiation)
- “MAIL FROM:” (envelope sender)
- “RCPT TO:” (envelope recipient)
- “DATA” (content, ended by <CRLF>.<CRLF>)
- “QUIT” (goodbye)

Message store

- In database
 - Only accessible via IMAP, POP3
- In flat files
 - Also accessible via direct access
 - Enables “grepping” the message store

Mbox format

- Ordinary file with
 - multiple messages
 - separated by “From_” at start of line
 - has extra blank line at end of message
 - quotes “From_” to “>From_”
- “From <envelopesender> <date> <optionalinfo>”

MMDF format

- Variant of mbox format
 - Uses ^A^A^A^A (4 control-A's) at begin and end of message
 - Optionally has the mbox "From " information

MH format

- Mailbox is a directory
- Every message is a file with a numeric name
- Used by mh, nmh, xnmh MUA's

Maildir format

- Mailbox is again a directory
- Subdirectories tmp, new, cur
- Arriving mail: tmp/<time>.<pid>.<host>
- No mailbox locking needed
- Works reliably over NFS

Mailbox locking

- Uses flock, lockf, fcntl system calls
- Does not always work reliably over NFS
- Needed if delivery agents and/or access agents operate on the same file (mailbox)