An Introduction
to
Sendmail and Sendmail.cf
or
Showing Sendmail Who's Boss

Frederick M. Avolio
Digital Equipment Corporation
6406 Ivy Lane, COP/8–6
Greenbelt, MD 20770

avolio@dco.dec.com

UN047

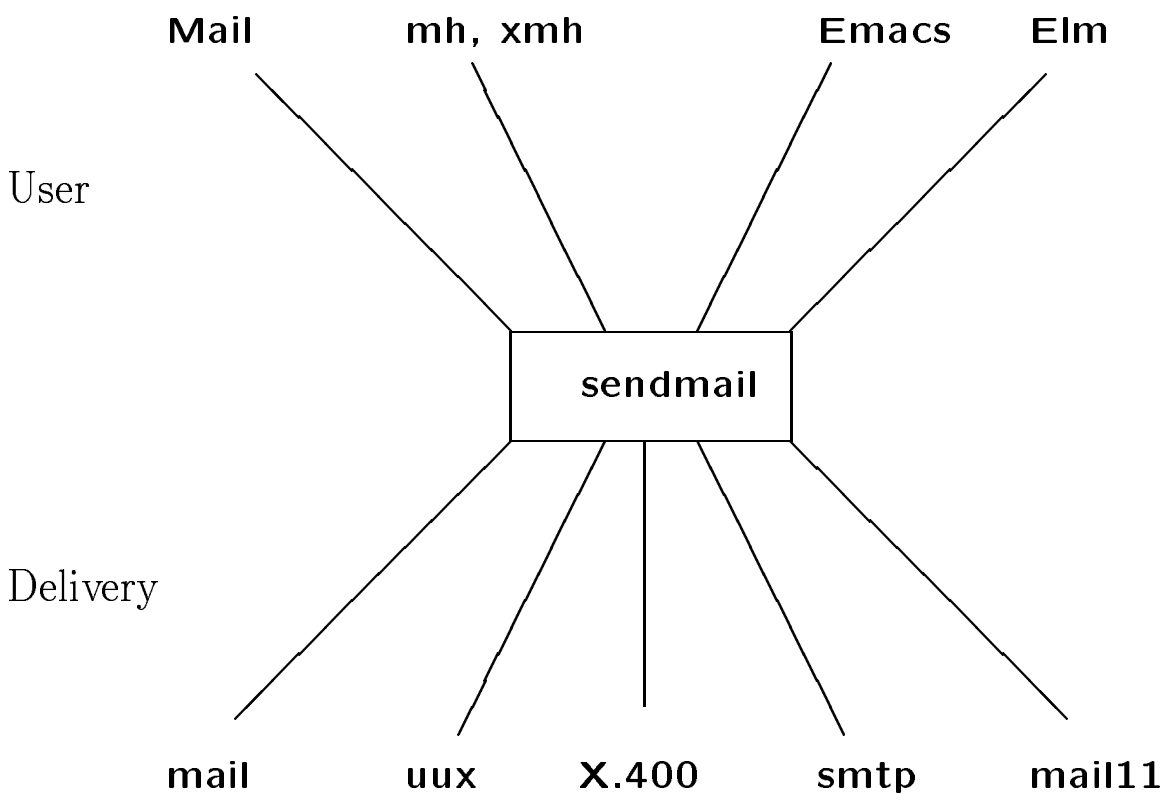
"You are in a maze of twisty little sendmail rules, all obscure."

(Thanks to: Mike Shaddock, rti-sel!shaddock and Bill Cheswick who pointed it out to me...)

Sendmail: Overview

- General purpose internet mail routing
- Protocol independent
- Mail deliverer
- Header/address formats
- Sendmail.cf file
- Publically available code
  (Can run on System V but best with BSD sockets, BSD, ULTRIX, SunOS, etc.)

Sendmail: Overview



Sendmail: Delivery

1. Created and given to sendmail
2. group copies for delivery by host
3. determine delivery method (air mail, special delivery, overnight express, camel-cart, boat mail)
4. modify the information on the envelop if needed
5. for each host and mailer try to deliver
   - save in queue if cannot
   - return to sender on error

Sendmail: Delivery

...and BIND

1. Check for specific MX record(s) for host. If exist, try to reach one at a time in precedence order.
2. If no specific MX record, check for A record(s). If exist, try connection to them.
3. If no A record and no specific MX record try for general MX record . (e.g., *.dco.dec.com). If exist, try to reach one at a time in precedence order.

Sendmail: Files

/var/spool/mqueue

df*	The data file. (The body of the message.)
lf*	The lock file. The job is currently being processed. Sendmail willl not try to process it.
qf*	The queue control file. Mail envelope information, status information, time information (how long it has sat in the queue), and the headers are here.
tf*	A temporary file. This is the *qf** file while being built.
xf*	A transcript file. This shows everything that happens during the mail transfer. When mail is delivered (or when sendmail gives up for now) this file goes away.

Sendmail: Files

/var/spool/mqueue

```
dfAA00826
lfAA01686
qfAA00826
qfAA01686
syslog
syslog.0
syslog.1
syslog.2
syslog.3
syslog.4
syslog.5
syslog.6
syslog.7
xfAA01686
```

Sendmail: Files

Examples – qf*

```
P695447
T695159735
K695401658
N69
I18487
DdfAA02849
MDeferred
S<avolio@gildor.dco.dec.com>
Rsomnod::person
H?P?return-path: <avolio@gildor.dco.dec.com>
Hdate: Sat, 11 Jan 92 14:55:34 -0500
HFrom: avolio@gildor.dco.dec.com (Frederick M. Avolio)
Hmessage-id: <9201111955.AA13478@gildor.dco.dec.com>
HTo: uig@urc.dco.dec.com
Hsubject: xcd
```

Sendmail.cf: Format

- Designed to be easy to parse by sendmail
- Lines of different types — first character
- Blank lines ignored
- # — comments
- TAB — continuation

Sendmail.cf: Format

R and S

- S*n* — Ruleset *n*
- R*lhs* <TAB> *rhs* <TAB> *comments*
- Example

```
R$-@$w          $1              Example
```

Sendmail.cf: Format

D – Define Macro

- **D**X**value**

  X — uppercase* single letter
- Example

```
DDdco.dec.com
```

$D expands to "dco.dec.com" in rules

Sendmail.cf: Format

C and F – Define Classes

- A set of words, defined directly (using C) or read from file (using F)
- C

  C*c***word1 word2 ...**

  -OR-

  C*c***word1**

  •

  •

  •

  C*c***wordN**

- F

  F*c***filename [format]**

Sendmail.cf: Format

C and F – Define Classes

Continued

- Examples

```
# these are not really domains and should never show up
CDenet decnet uucp
# EDIT-- if have uucp, take off the comment character
FZ/usr/var/uucp/L.sys %[0-9a-zA-Z_-]
```

Later, $=D or $=Z will expand to a set of words

Sendmail.cf: Format

- M – define mailer (see examples later)
- H – define header
- O – Set option

  O*o*value

- T – define trusted users

  T*user1 user2 ...*

-OR-

  T*user1*
  T*user2*
  •
  •
  •

Sendmail.cf: Semantics

The Left Hand Side

metasymbol	matches
$*	zero or more tokens*
$+	one or more tokens
$-	exactly one token
$=X	any token in class X
$~X	Any token *NOT* in X
$X	Value of macro X

Sendmail.cf: Semantics

The Left Hand Side: Example

$–@$*

applied to “avolio@decuac.dec.com”

$1 — avolio

$2 — decuac.dec.com

Sendmail.cf: Semantics

The Right Hand Side

metasymbol	meaning
$\$n$	item #n matched from LHS
$\$>m$	call ruleset m. Value returned in place
$\$\#mailer$	send it to mailer $mailer$
$\$@host$	host part for mailer
$\$:user$	user part for mailer
$\$@$	Return from ruleset with rest of RHS
$\$:$	Go on to next rule in ruleset, e.g., R$+ $:$>7$1

Sendmail.cf: Rulesets

Standard Rulesets

From__ 3 $\Rightarrow$ 1 $\Rightarrow$ 4 $\Rightarrow$ 3 $\Rightarrow$ 1 $\Rightarrow$ S $\Rightarrow$ 4
To__ 3 $\Rightarrow$ 0 $\Rightarrow$ 4

From: 3 $\Rightarrow$ 1 $\Rightarrow$ S $\Rightarrow$ 4

To: 3 $\Rightarrow$ 2 $\Rightarrow$ R $\Rightarrow$ 4

Cc: 3 $\Rightarrow$ 2 $\Rightarrow$ R $\Rightarrow$ 4

Sendmail.cf: Rulesets

Standard Rulesets

- S3
  - Always done first
  - puts in "internal form" (*focuses on host part*)
  - In ULTRIX sendmail.cf, uses S6 and S8 (to make less complex)
- S4
  - always done last
  - turns any other "internal" form back to external form
  - E.G., *user@<host.UUCP>* might become *host!user*

Sendmail.cf – Rulesets

Standard Rulesets

- S0
  - Handles the address in the envelope
  - Expects in *internal* (S3) form
  - Decides how to send the mail
  - Returns the triple
    mailer, host, users
- S1 and S2
  - always used, one or the other
  - Changes the sender/receiver lines in the header for ALL mail, so should normally *ALWAYS* be empty.

Sendmail.cf – Rulesets

Rules R and S

- Like S1 and S2 except mailer specific
- Specified in the mailer definition
- R – Recipient Fields
- S – Sender field
- Done after (either) S1 or S2

Sample Sendmail.cf

Local Configuration Options

```
DDdco.dec.com
DTdec.com
CDenet cop8
Dj$w.$D
#Dj$w
DRrelay.$D
DZ$R
#FZ/usr/var/uucp/L.sys %[0-9a-zA-Z_-]
```

Sample Sendmail.cf

General Configuration Options

```
DVfma-091991
# my name
DnMAILER-DAEMON
# UNIX header format
DlFrom $g  $d
# delimiter (operator) characters
Do.:%@!^=/[]
# format of a total name
Dq$g$?x ($x)$.
# SMTP login message
De$j Sendmail $v/$V ready at $b
```

Sample Sendmail.cf

Options

```
# location of alias file
OA/etc/aliases
# default delivery mode (deliver in background)
Odbackground
# temporary file mode
OF0600
# default UID
Ou1
# default GID
Og1
```

Sample Sendmail.cf

Options

```
# location of help file
OH/etc/sendmail.hf
# log level
OL9
# send to me too in alias expansion
Om
# messages may have old style headers (blanks vs. commas)
Oo
# queue directory
OQ/usr/spool/mqueue
# read timeout -- violates protocols, but what the heck
Or2h
# status file
OS/etc/sendmail.st
```

Sample Sendmail.cf

Options

```
# queue up everything before starting transmission
Os
# try this long before returning as undeliverable
OT3d
# load average to queue vice send
Ox8
# load average to refuse smtp connections
OX12
###   Trusted users   ###
Troot daemon uucp network avolio
```

Sample Sendmail.cf

Headers

```
###   Format of headers   ###
H?P?Return-Path: <$g>
H?R?Received: by $j ($v/$V);
        id $i; $b
H?D?Date: $a
H?F?From: $q
HSubject:
H?M?Message-Id: <$t.$i@$j>
```

Sample Sendmail.cf

Ruleset 3

```
S3

# handle "from:<>" special case
R<>        $@EEEEEK        turn into magic token

# basic textual canonicalization
R$*<$*<$*<$+>$*>$*>$*   $4
R$*<$*<$+>$*>$*         $3
R$*<$+>$*         $2     basic RFC821/822 parsing
R$*<$*>$*         $1$2$3  in case recursive
```

Sample Sendmail.cf

Ruleset 3 — continued

```
# more miscellaneous cleanup
R$+                 $:$>8$1          host dependent cleanup
R$+@$+              $:$1<@$2>        focus on domain
R$+<$+@$+>          $1$2<@$3>        move gaze right
R$+<@$+%$+>         $1%$2<@$3>       move gaze right
R$+<@$+>            $@$>6$1<@$2>     already canonical

# convert old-style addrs to domain-based addr
R$-%$+              $:$1<@$2>        user%host
R$+<@$+>            $@$>6$1<@$2>     now canonical
R$-!$+              $@$>6$2<@$1.UUCP> resolve uucp names
```

Sample Sendmail.cf

Rulesets 8 and 6

```
S8


S6
R$*<$*.>$*          $1<$2>$3            drop trailing dot
# Basically take a last minute look to see if we've
# "focused on" our hostname.  if so kick it back
# check all possible names for us.
R$*<@$j>$*          $:$1$2
R$+<@$=w>           $:$1
R$-$+<@$w>          $@$>3$1$2
R$-$+<@$=w.$D>      $@$>3$1$2
R$-$+<@$=w.$=D>     $@$>3$1$2           other local domains
```

Sample Sendmail.cf

Rewriting Rules 1 and 2

```
#  Sender Field Pre-rewriting  #
S1
# Empty

#  Recipient Field Pre-rewriting  #
S2
# Empty
```

Sample Sendmail.cf

Ruleset 0

```
S0
# handle one step at a time.....

# error?
REEEEEK                 $#local$:MAILER-DAEMON
# Numeric addr?
R$*<@[$+]>$*            $#tcp$@$R$:$1<@[$2]$3>
# empty?  try again.
R$*<@>              $@$>9$1
# simple (local) IP address?
R$+<@$->              $#tcp$@$2$:$1<@$2>
# UUCP address?
R$+<@$~Z.UUCP>      $#tcp$@$Z$:$1<@$2.UUCP>
```

Ruleset 0—continued

```
# IP address we can get to?
R$+<@$-.$D>             $#tcp$@$2.$D$:$1<@$2.$D>
R$+<@$+.$T>             $#tcp$@$2.$T$:$1<@$2.$T>

# All other IP addrs to RELAY
R$*<@$+>$*              $#tcp$@$R$:$1<@$2>$3

# everything else must be a local name
R$+             $#local$:$1             local names
```

Ruleset 9

```
S9
# rerun ruleset 3 and then call 0 again

R$+                     $:$>3$1
R$+                     $@$>0$1
```

Sample Sendmail.cf

Mailer Definitions

```
Mlocal, P=/bin/mail, F=lsDFmn, S=10, R=10,
        A=mail -r $f -d $u

Mprog,  P=/bin/sh,   F=lsDFRe,   S=10, R=10,
        A=sh -c $u

Mtcp,   P=[IPC], F=msDFMueCXLR, S=16, R=14,
        A=IPC $h
```

Sample Sendmail.cf

Mailer-Specific Rewriting Rules

```
#                       Used by local and prog
S10

REEEEEK                  $@MAILER-DAEMON   error return
```

Mailer-Specific Rewriting Rules

```
#                       SENDER RS for tcp
S16
#R$-              $:$1<@$D>
R$-               $:$1<@$j>
#R$-              $:$1<@$R>
R$+               $@$>14$1
#                        RECEIVER RS for tcp
S14
# tack on our name and domain
R$-                    $@$1<@$j>
R$-<@$w>               $@$1<@$j>
R$+<@$+>               $@$1<@$2>
```

Final Output — Ruleset 4

```
#  Final Output Post-rewriting,  Undo any
#  special tags, take out of internal form
S4

R$*<@$->$*              $:$1<@$2.$D>$3
R$+<@$-.UUCP>           $2!$1
R$*<$+>$*               $1$2$3                  defocus
```

Testing Changes

```
% /usr/lib/sendmail -bt -Ctest.cf

ADDRESS TEST MODE
Enter <ruleset> <address>
> 0,4 user@host.umd.edu
> 1,14,4 avolio@decuac.dec.com
> 2,19,4 murphy@burfle.dco.dec.com
> 1,4,3,1,14,4 host!user
```

Testing Changes

```
% /usr/lib/sendmail -bt -Ctest.cf

ADDRESS TEST MODE
Enter <ruleset> <address>
> 0,4 u@h.d
3   input: "u" "@" "h" "." "d"
8   input: "u" "@" "h" "." "d"
8 returns: "u" "@" "h" "." "d"
6   input: "u" "<" "@" "h" "." "d" ">"
6 returns: "u" "<" "@" "h" "." "d" ">"
3 returns: "u" "<" "@" "h" "." "d" ">"
0   input: "u" "<" "@" "h" "." "d" ">"
0 returns: "^V" "tcp" "^W" "decuac" "." "dec" "." "com" \
 "^X" "u" "<" "@" "h" "." "d" ">"
4   input: "^V" "tcp" "^W" "decuac" "." "dec" "." "com" \
 "^X" "u" "<" "@" "h" "." "d" ">"
4 returns: "^V" "tcp" "^W" "decuac" "." "dec" "." "com" \
 "^X" "u" "@" "h" "." "d"
>
```

Testing Changes

```
> 1,14,4 host::user
 3   input: "host" ":" ":" "user"
 8   input: "host" ":" ":" "user"
 8 returns: "host" ":" ":" "user"
 6   input: "user" "<" "@" "host" "." "ENET" ">"
 6 returns: "user" "<" "@" "host" "." "ENET" ">"
 3 returns: "user" "<" "@" "host" "." "ENET" ">"
 1   input: "user" "<" "@" "host" "." "ENET" ">"
 1 returns: "user" "<" "@" "host" "." "ENET" ">"
14   input: "user" "<" "@" "host" "." "ENET" ">"
14 returns: "user" "<" "@" "host" "." "ENET" "." "dec" "." "com" ">"
 4   input: "user" "<" "@" "host" "." "ENET" "." "dec" "." "com" ">"
 4 returns: "user" "@" "host" "." "ENET" "." "dec" "." "com"
>
```

References

Allman, Eric, "Sendmail – Installation and Operation Guide," *Ultrix-32 Supplementary Documents*, vol. 3, Digital Equipment Corporation, Maynard, MA, 1986.

Allman, Eric and Amos, Miriam, "Sendmail Revisited," *USENIX Association Conference Proceedings*, pp. 547-555,USENIX Association, P.O. Box 7, El Cerrito, CA 94530, Portland, June 1985.

Avolio, F., Vixie, P., *Sendmail: Theory and Practice*, Forecoming.

decuac.dec.com: pub/decus/generic.cf,dumb-client.cf

Appendix

Predefined Macros

a	The origination date in Arpanet format
b	The current date in Arpanet format
c	The hop count
d	The time in ctime format
f	The sender (from) address
g	The sender address relative to the recipient
h	The recipient host
i	The queue id (usually built from the process id)
p	The sendmail process id
r	The protocol used
s	Sender's host name
t	Numeric representation of the current time
u	The recipient user
v	The version number of the compiled Sendmail
w	The hostname of this host.
x	The full name (personal name) of the sender
y	The name of the senders tty
z	The home directory of the recipient

Macros You *must* Define

e	The SMTP login message
j	The fully qualified name of this host
l	The format for a UNIX *From* line
n	The name to use for the mail daemon when Sendmail returns mail because of error conditions
o	The set of operators (delimiters)
q	The default format for sender addresses

Date Format Examples

Arpanet (a, b) format – Tue, 14 Jan 92 10:49:27 -0500

UNIX (ctime) format – Tue Jan 14 10:49:35 1992

Numeric (t) format – 9201141049