

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

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UN047

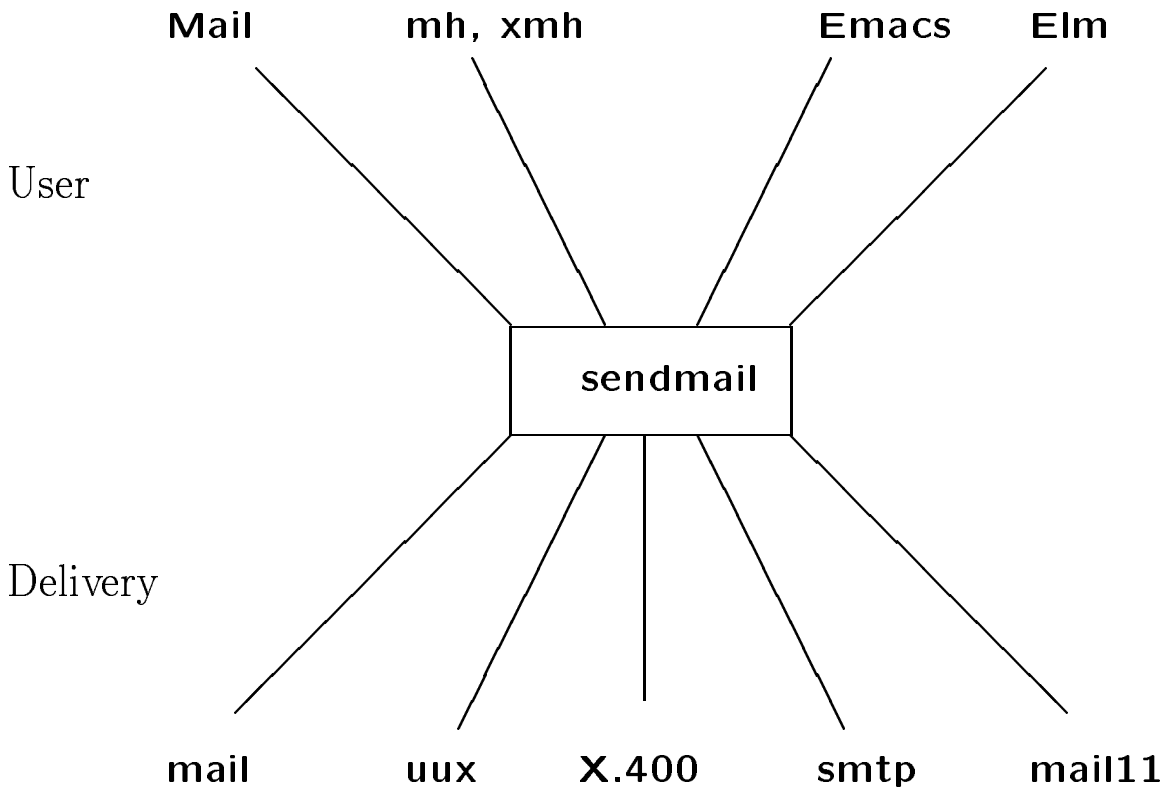
**“You are in a maze of
twisty little sendmail rules,
all obscure.”**

(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, camelcart, 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 will 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
- **$Rlhs$** <**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*cword1 word2 ...*

-OR-

C*cword1*

-
-
-

C*cwordN*

- F

F*cfilename [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*_{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 <i>NOT</i> 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
$\#\textit{mailer}$	send it to mailer \textit{mailer}
$\@\textit{host}$	host part for mailer
$\:\textit{user}$	user part for mailer
$\$@$	Return from ruleset with rest of RHS
$\$:$	Go on to next rule in ruleset, e.g., $R\$+ \qquad \$:\$>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
0H/etc/sendmail.hf
# log level
0L9
# send to me too in alias expansion
0m
# messages may have old style headers (blanks vs. commas)
0o
# queue directory
0Q/usr/spool/mqueue
# read timeout -- violates protocols, but what the heck
0r2h
# status file
0S/etc/sendmail.st
```

Sample Sendmail.cf

Options

```
# queue up everything before starting transmission
0s
# try this long before returning as undeliverable
0T3d
# load average to queue vice send
0x8
# load average to refuse smtp connections
0X12
###   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<> \$@EEEEEEK 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>

Sample Sendmail.cf

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

Sample Sendmail.cf

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
```

Sample Sendmail.cf

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>
```

Sample Sendmail.cf

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@burfile.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*, Digital Press, 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 <i>From</i> 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