Wietse's mailer project: Turning off Sendmail forever

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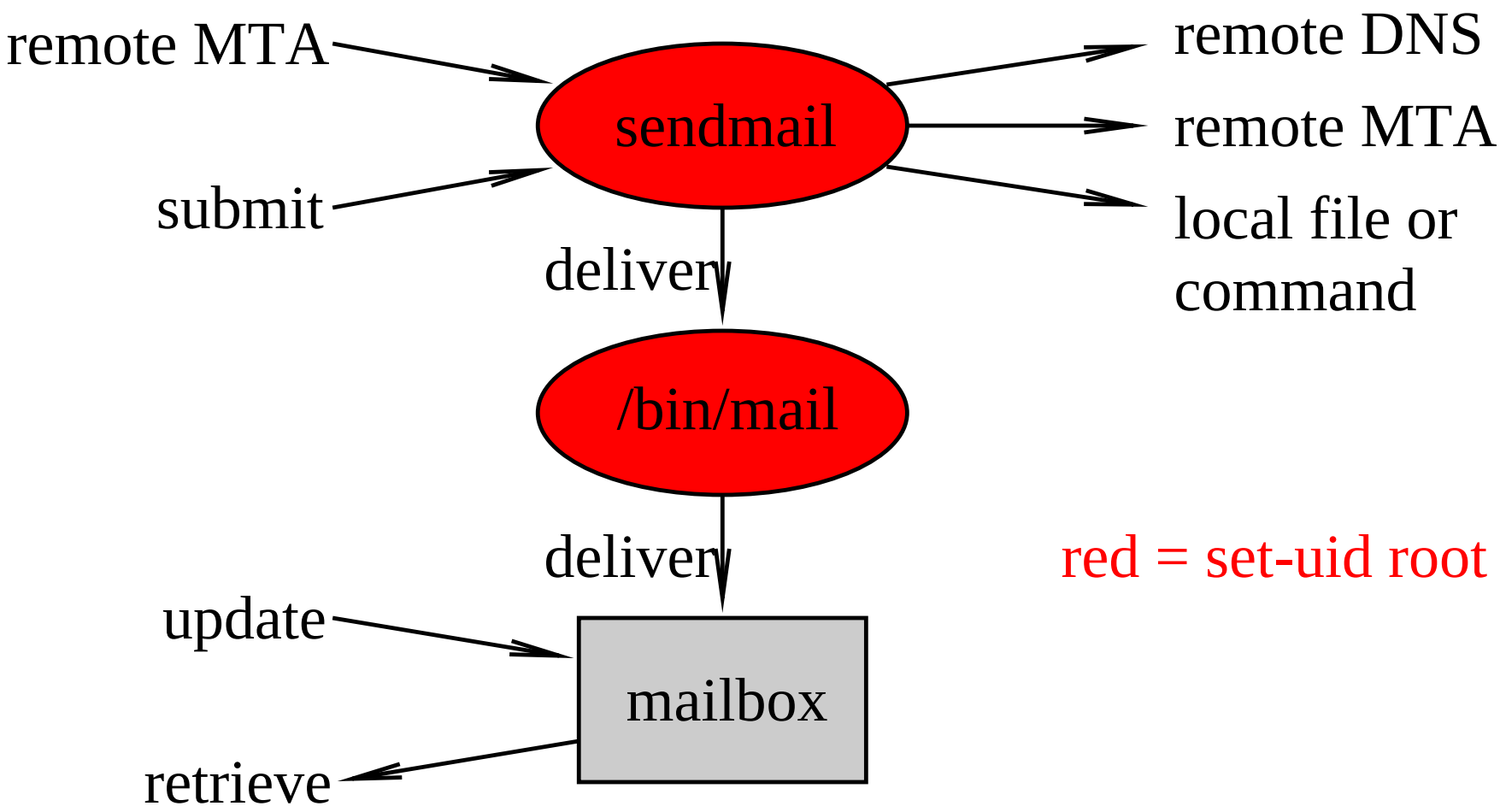
cover.fig

Overview of presentation

- Intro
- Why write yet another UNIX mailer?
- Why is the UNIX mail system so vulnerable?
- VMailer architecture and implementation
- Early experiences and plans

UNIX mail system: sendmail and /bin/mail



unix-mail.fig

Sendmail and /bin/mail advisories

CA-88:01	Sendmail 5.58	run any command (debug)
CA-90:01	SUN Sendmail	
CA-91:01a	SUN /bin/mail	root shell (local)
CA-91:13	Ultrix /bin/mail	root shell (local)
CA-93:15	SUN Sendmail	write any file (remote)
CA-93:16	Sendmail 8.6.3	run any command (from)
CA-94:12	Sendmail 8.6.7	root shell (-d bignumber)
		read any file (-oE filename)
CA-95:02	/bin/mail	write any file (race)

Sendmail and /bin/mail advisories (cont)

CA-95:05	Sendmail 8.6.9	any command/file (ident)
CA-95:08	Sendmail V5	any command/file
CA-95:11	SUN Sendmail	root shell (-oR host -f cmd)
CA-95:13	Sendmail 8.7.0	root shell (syslog)
CA-96.04	Sendmail 8.7.3	root shell (dns newline)
CA-96.20	Sendmail 8.7.5	root shell (fullname buffer)
		default uid/gid (getpwuid)
CA-96.24	Sendmail 8.8.2	root shell (argv[0])
CA-96.25	Sendmail 8.8.3	group id (:include:, .forward)
CA-97.05	Sendmail 8.8.4	root shell (mime buffer)

Wietse’s mailer primary goals

- Wide deployment by giving it away
- Compatibility: make transition easy
- Performance: faster than the competition
- Security: no root shells for random strangers
- Flexibility: C is not an acceptable scripting language
- Reliability: behave rationally under stress
- Example for book with Dan

The book with Dan

- Is late (so what's new)
- One new tool for each chapter?
- VMailer: programming chapter
- Coroner's Toolkit: investigating a break-in aftermath

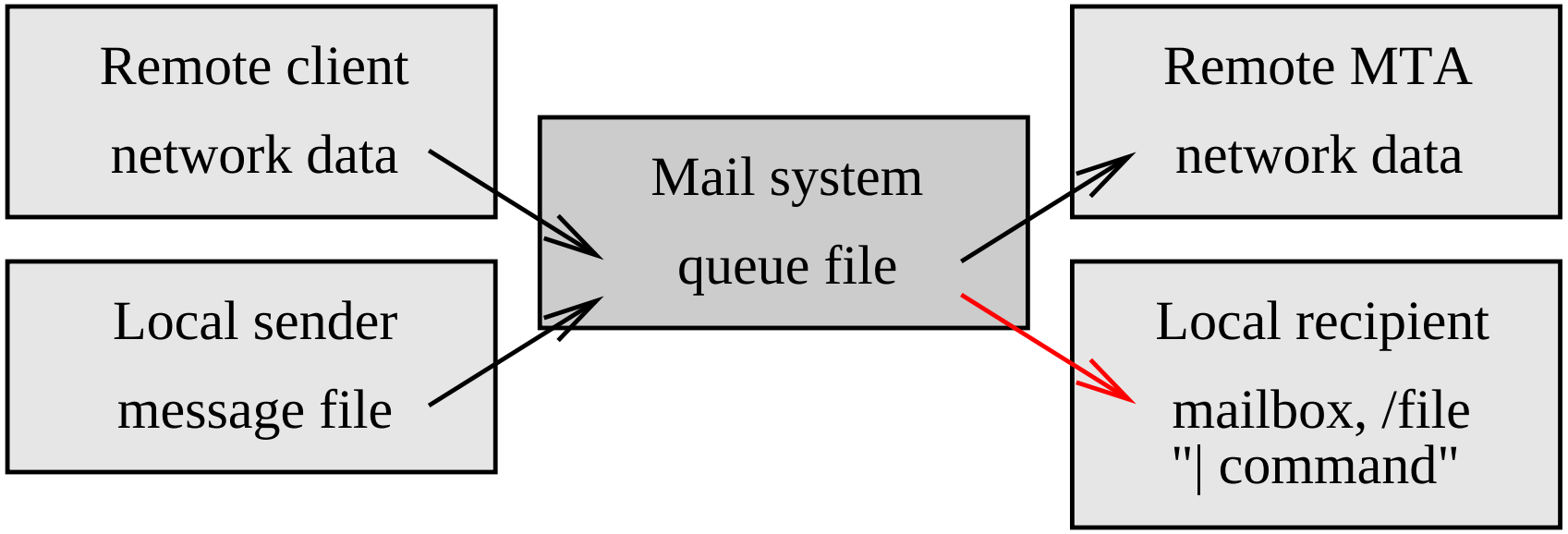
Challenges of implementing UNIX mail

- Network protocols (lots of broken software to talk to)
- Concurrent mail database access
- Mail address parsing, rewriting, and routing
- Queue management

All this plus: SPAM/relay control, security and performance

challenges.fig

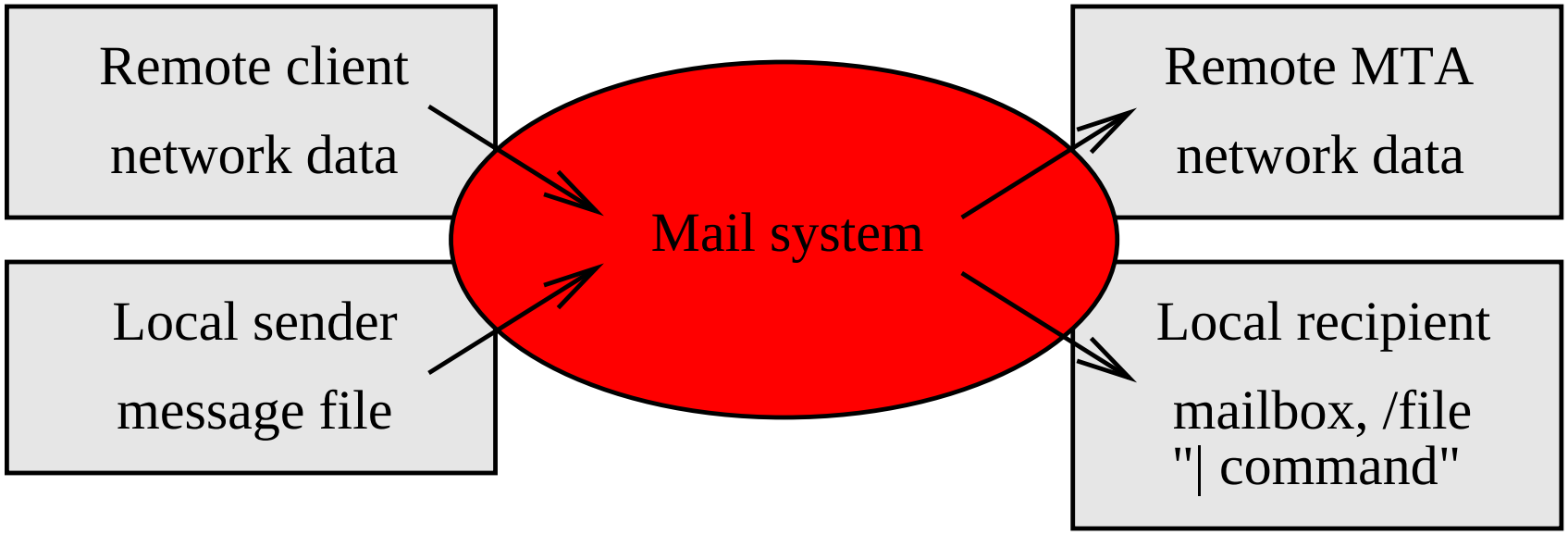
Security challenge: multiple privilege levels



- Entry into mail queue involves "mail system" privilege
- Local delivery involves root privilege

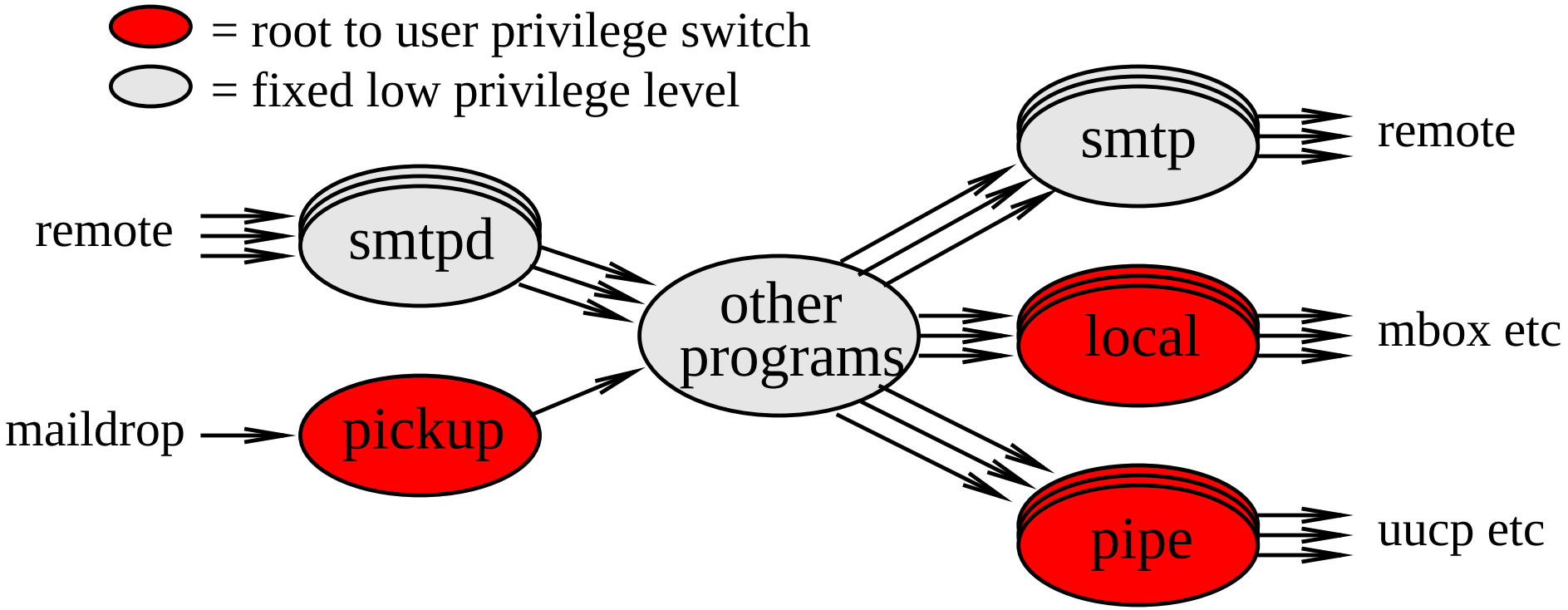
security-challenge.fig

Monolithic mailer: no damage control



- The entire mail system runs at the highest privilege level
- Result: one vulnerability compromises the entire host

VMailer: multiple layers of defense



- Partitioned architecture for damage control
- Most programs run in chroot/low privilege jail
- No trust in queue files or in IPC messages

damage-control.fig

Eliminating security problems

- No set-uid programs
- No /tmp race conditions
- No remote data in shell variables or shell commands
- No fixed-length string buffers
- No unbounded string sizes, either :-)

Compatibility

All the good things from sendmail, none of the pain

- /etc/aliases, NIS aliases, even NetInfo aliases
- /var/spool/mail/user, /var/mail/user, user.lock files
- $HOME/.forward, :include:/file/name
- Delivery to /file/name
- Delivery to "| command"
- No sendmail.cf file

Address rewriting and routing

- No rewriting language in version 1 (only few need it)
- Table-driven operation (db, dbm, NIS, NetInfo)
  - Canonical: substitute any user/address/domain (S3)
  - Virtual: redirect any user/address/domain (S0)
  - Transports: route any domain to transport:relayhost
  - Relocated: bounce text per local recipient
  - Aliases: redirect or expand local recipient

rewriting.fig

SPAM mail

Basic spam controls:

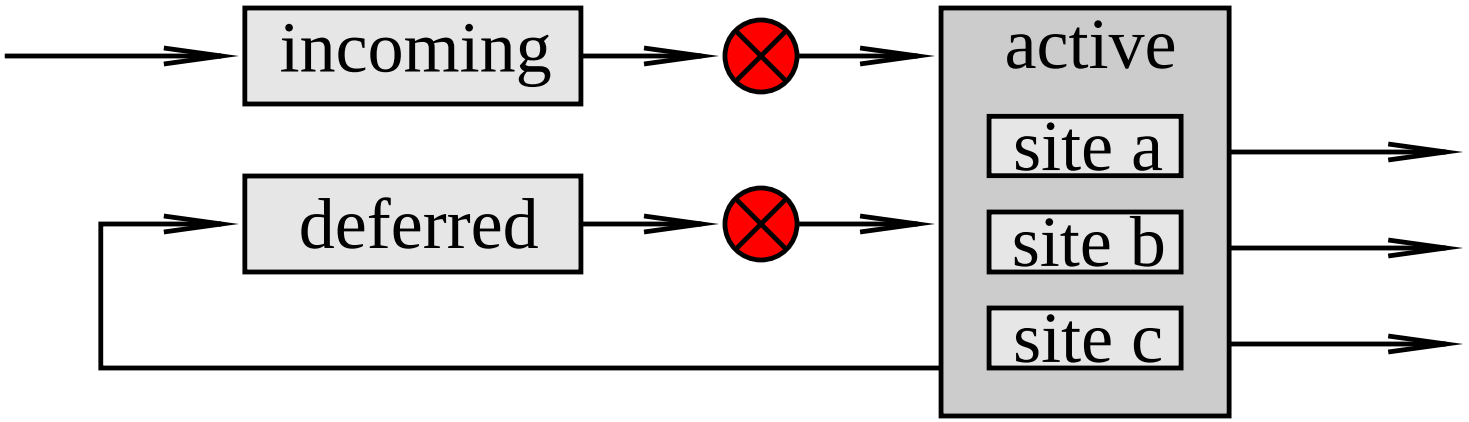
- Relay control (default: from/to own network/domain)
- SMTP client blacklist (name/domain/address/network)
- Sender domain blacklist
- Sender domain DNS lookup (soft failure)

TODO: support for local policies:

- Pattern-based filter (helo/relay/envelope/header/body)

spam-control.fig

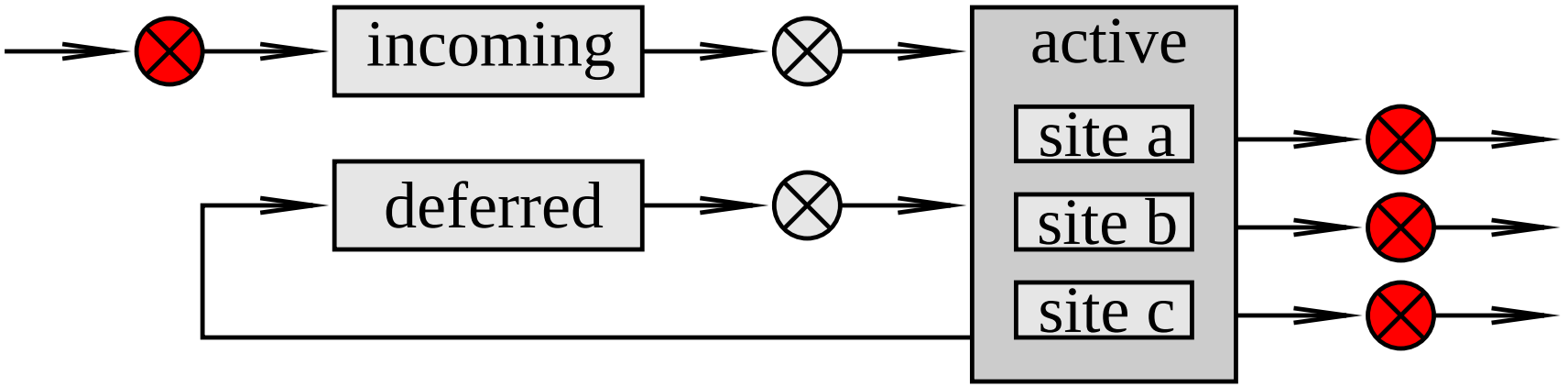
Queue management



- Leaky bucket: new/delayed mail to small in-core queue
- Round-robin walk to select destination site queue
- Random walk within destination site queue
- Exponential backoff for dead sites (up to some # sites)

queue-mgt.fig

Connection management



- No crashing when mail starts pouring in after outage

  Controlled number of inbound connections

- No annoying thundering herd deliveries

  "Slow start" of parallel connections to the same site

connection-mgt.fig

Lies, damned lies, and benchmarks

Good news: up to three times faster than qmail:

- From network to local recipient
- From network to remote recipient

Good news: at least as fast as qmail:

- From network to mailing list
- Does multi-recipient transfers by default

Bad news: the mail system is horribly slow

benchmarks.fig

Mail system performance limits (TP760)

- It takes gross inefficiency to saturate the CPU
  FreeBSD does 100 fork()+exec()/s on a P133

- It takes a moderate effort to saturate the network
  VMailer/qmail do 75 deliveries/s on 10Mb/s LAN

- It’s a no-brainer to saturate the BSD fast file system
  VMailer saturates at 5.3 messages/s (1 queue file)
  qmail saturates at 1.8 messages/s (3 queue files)

bottleneck.fig

Hardware performance evolution in 10 years

Typical hardware in 1988		Improvement
CPU speed	5 MIPS	100
Disk size	300 MB	10-100
Memory	8 MB	10-100
Disk bandwidth	2 MB/s	10
Light speed	3.10^8 M/s	1

hardware.fig

Apples vs oranges: observed speedup factors

2 x	Soft metadata updates (Ganger and Patt, with metadata-intensive applications) To be adopted in FreeBSD FFS soon
5-10 x	Append/truncate, not create/delete, small files
7 x	Prestoserve non-volatile cache, small files

Mail performance is limited by latencies, not by bit rates!

Combining tricks doesn’t necessarily give more speedup!

VMailer status and future plans

- December 1997: Sendmail turned off forever
- January 1998: closed alpha release
- 2Q1998: public beta release
- BSDI DEC *BSD HP IBM LINUX NEXT SGI SUN
- Won’t run on Windows
- More info on: http://www.vmailer.org/