# Linux System Administration and IP Services

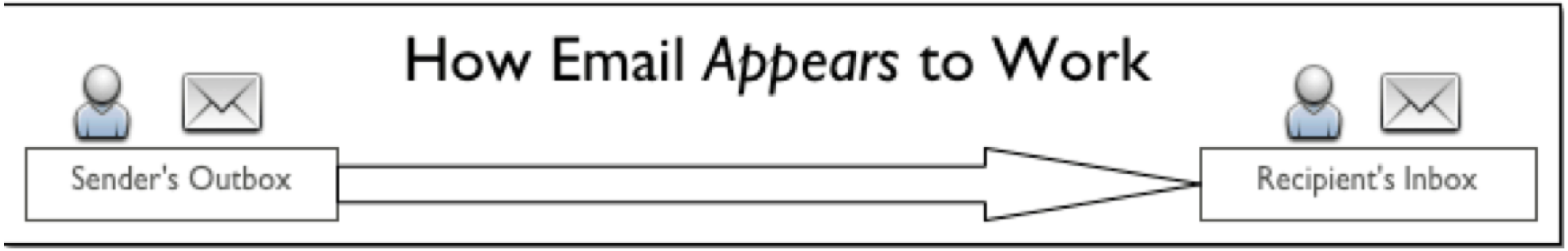
## Email

## SMTP and Postfix

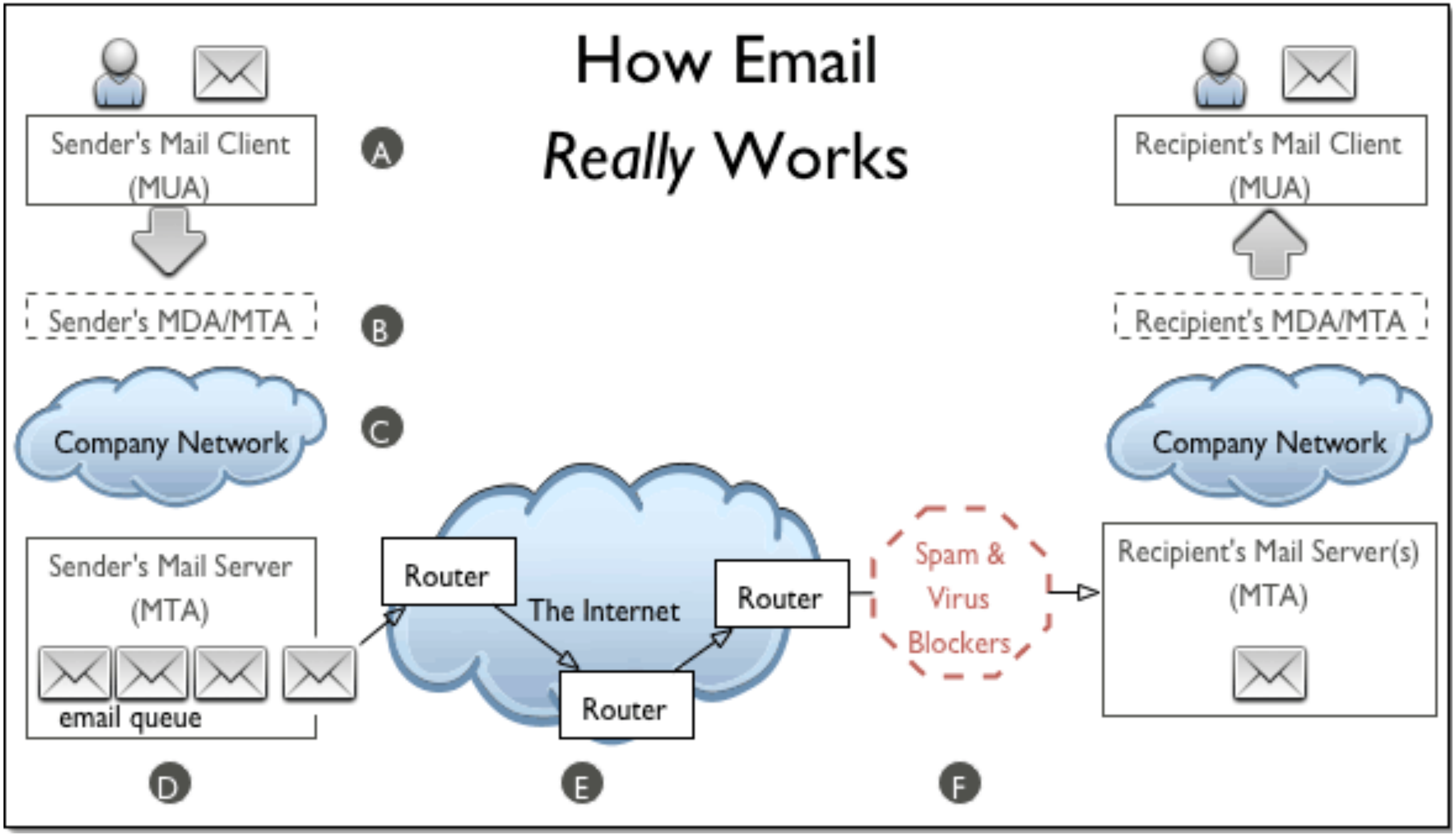
# Scope

- How Email Appears to Work
- How Email Really Works
- Mail User Agent (MUA)
- Message Format
- Mail Delivery Agent (MDA)/ Mail Transfer Agent (MTA)
- Firewalls, Spam and Virus Filters

# How Email Appears To Work

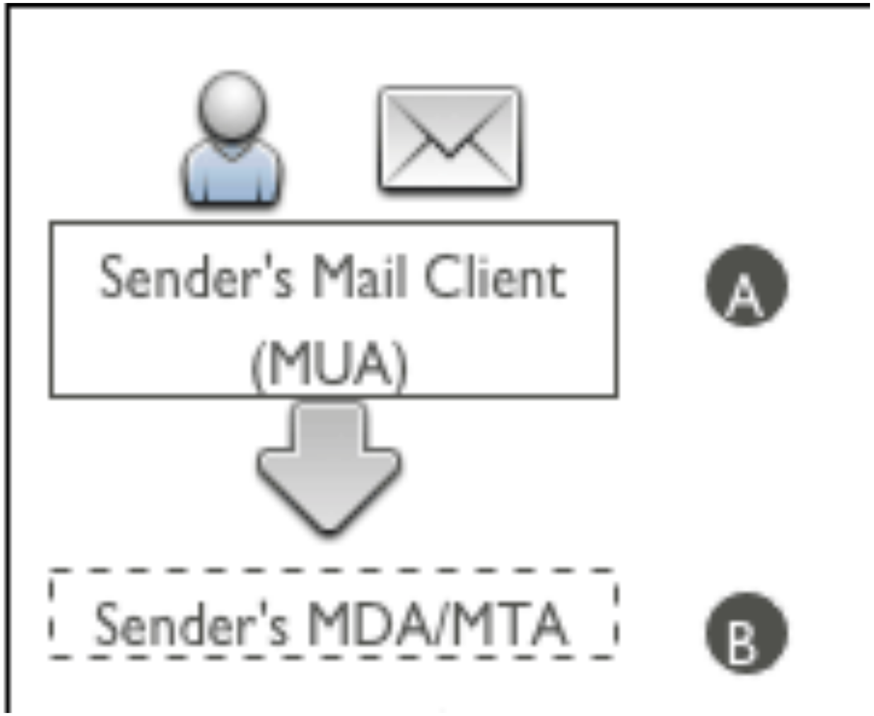


# How Email Really Works



# Mail User Agent (MUA)

- Application the originating sender uses to compose and read email
  - **Pine, MH, Elm, mutt, mail, Eudora, Marcel, Mailstrom,**
  - **Thunderbird, Pegasus, Express, Netscape, Outlook, ...**
- You can have multiple MUAs on one system - end user choice



# Message Format

- **Envelope**
  - Routing information for the "postman"
- **Message Header**
  - Sender
  - Recipients (simple, lists, copies, blind copies)
  - Other fields of control (date, subject)
- **Message Body**
  - Free text
  - Structured document (i.e.: MIME)

# Message Format

From: Philip Hazel <ph10@cus.cam.ac.uk>
To: Julius Caesar <julius@ancient-rome.net>
Cc: Mark Anthony <MarkA@cleo.co.uk>
Subject: How Internet mail works

Julius,
  I'm going to be running a course on ...

- Format was originally defined by RFC 822 in 1982
- Now superseded by RFC 2822
- Message consists of
  - Header lines
  - A blank line
  - Body lines

# Message Format

Embedded MUA uses interprocess call to send to MTA

Freestanding MUA uses SMTP to send mail

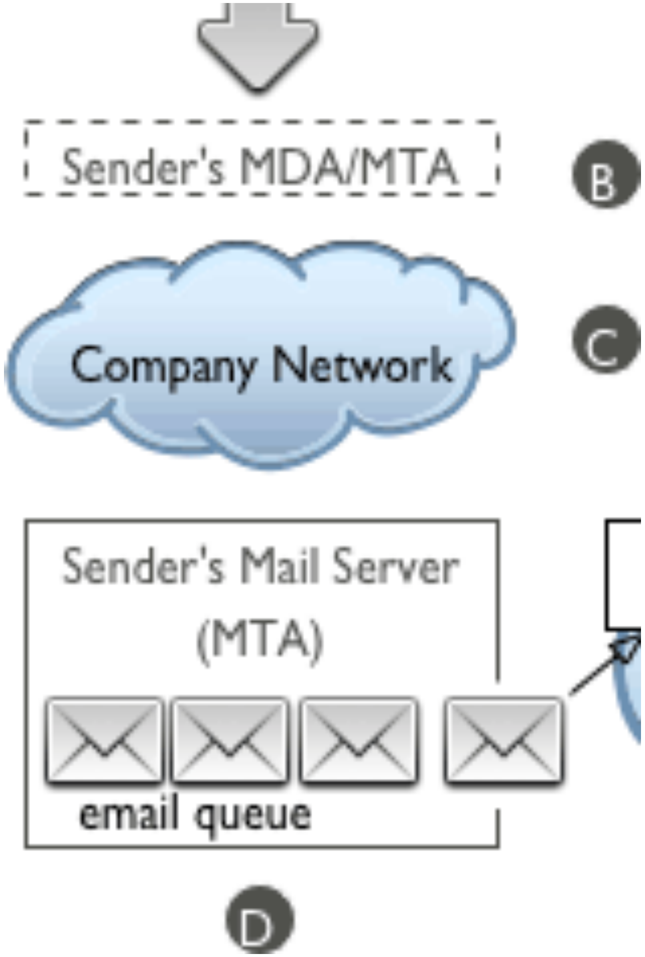
Headers added by the MUA before sending

```
From: Philip Hazel <ph10@cus.cam.ac.uk>
To: Julius Caesar <julius@ancient-rome.net>
cc: Mark Anthony <MarkA@cleo.co.uk>
Subject: How Internet mail works
Date: Fri, 10 May 2002 11:29:24 +0100 (BST)
Message-ID: <Pine.SOL.3.96.990117111343.19032A-100000@taurus.cus.cam.ac.uk>
MIME-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII




Julius,
  I'm going to be running a course on ...
```

# Mail Delivery Agent (MDA) / Mail Transfer Agent (MTA)



- MDA/MTA **accepts the email, then routes it to local mailboxes or forwards** it if it isn't locally addressed
- An email **can encounter a network cloud within a large company** or ISP, or the largest network cloud in existence: the Internet.

# Mail Delivery Agent (MDA) / Mail Transfer Agent (MTA)

Headers added by MTAs

```
Received: from taurus.cus.cam.ac.uk
           ([192.168.34.54] ident=exim)
           by mauve.csi.cam.ac.uk with esmtp
           (Exim 4.00) id 101qxX-00011X-00;
           Fri, 10 May 2002 11:50:39 +0100

Received: from ph10 (helo=localhost)
          by taurus.cus.cam.ac.uk with local-smtp
          (Exim 4.10) id 101qin-0005PB-00;
          Fri, 10 May 2002 11:50:25 +0100
```

From: Philip Hazel <ph10@cus.cam.ac.uk>

To: Julius Caesar <julius@ancient-rome.net>

cc: Mark Anthony <MarkA@cleo.co.uk>

...

# Message in transit

- A message is transmitted with an *envelope* :
  - **MAIL FROM:<ph10@cus.cam.ac.uk>**
  - **RCPT TO:<julius@ancient-rome.net>**
- The envelope is separate from the RFC 2822 message
- Envelope (RFC 2821) fields need not be the same as the header (RFC 2822) fields
- MTAs are (mainly) concerned with envelopes
  - **Just like the Post Office...**
- Error ("bounce") messages have null senders
  - **MAIL FROM:<>**

# An SMTP Session Example

```
220 server.bluepipe.net ESMTP Postfix
HELO macbook.catpipe.net
250 server.bluepipe.net
MAIL From: <regnauld@x0.dk>
250 2.1.0 Ok
RCPT To: <regnauld@nsrc.org>
250 2.1.5 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
Subject: hello
.
250 2.0.0 Ok: queued as 41A8B4F5C94
QUIT
221 2.0.0 Bye
```

# SMTP: response codes

- 1xx:positive preliminary answer (action to be continued in subsequent command)
- 2xx:positive response indicating that processing has been carried out as requested
- 3xx:positive partial response: the client must give more data for processing to continue
- 4xx:negative answer, processing is refused, but the command can be tried again later
- 5xx:negative answer, processing cannot be carried out

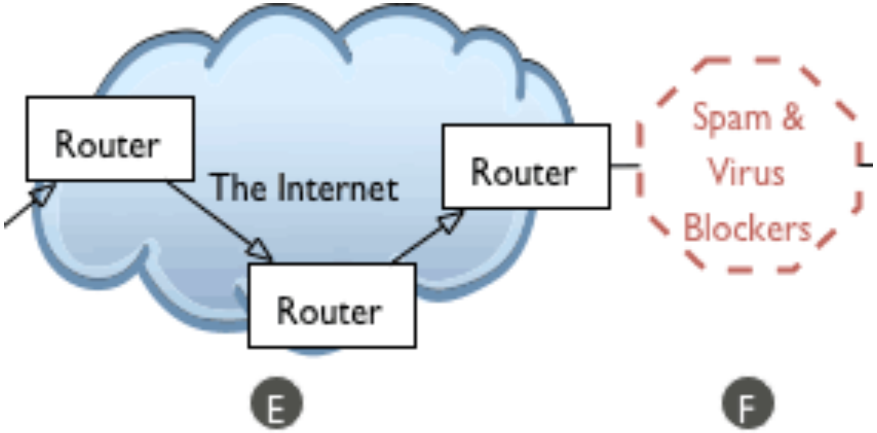
# ESMTP

```
220 server.bluepipe.net
ESMTP Postfix
EHLO macbook.catpipe.net
250-server.bluepipe.net
250-PIPELINING
250-SIZE 104857600
250-VRFY
250-ETRN
250-ENHANCEDSTATUSCODES
250-8BITMIME
250-DSN
250-BINARYMIME
250 CHUNKING
MAIL From: <regnauld@x0.dk>
...
```

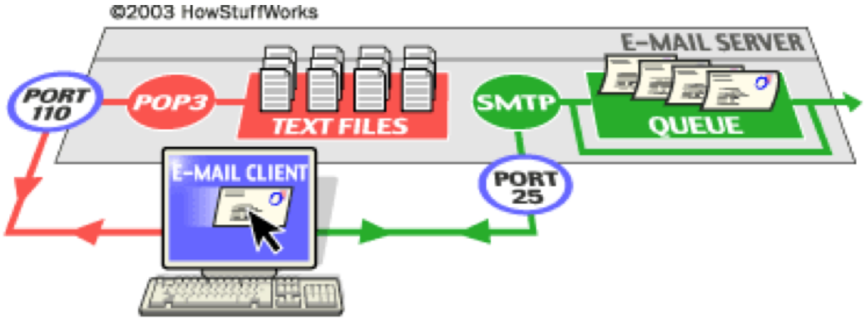
- Defined in RFC 1651 and following
  - Adds new functionality
    - Transport of 8bit MIME messages
    - Maximum message size limit
    - Function limitation (EXPN, VRFY, ...)
    - Other extensions (pipelining, private extensions)
- The welcome message for ESMTP is EHLO (instead of HELO). In case of a negative answer, the client must revert to the old protocol.

# Network Cloud

- large company network or ISP, or the largest network cloud in existence: the Internet.
- may encompass a **multitude of mail servers, DNS servers, routers, lions, tigers, bears (wolves!)** and other devices and services
- devices may be **protected by firewalls, spam filters and malware detection software** that may **bounce or even delete an email**



# Email Queue



- The email **enters an email queue with other outgoing email messages** .
- If there is a high volume of mail in the queue—**either because there are many messages or the messages are unusually large, or both** —
- the **message will be delayed in the queue until the MTA processes the messages ahead of it** .
- Transient failures will cause mail to stay in the queue until they are fixed for a configurable period of time:
- Permanent failures will cause the MTA to create a bounce message (from mailer-daemon) that gets sent to the original sender specified in the envelope UNLESS the sender field there is empty (<>)

image from http://computer.howstuffworks.com/e-mail-messaging/email3.htm

# MTA to MTA Transfer

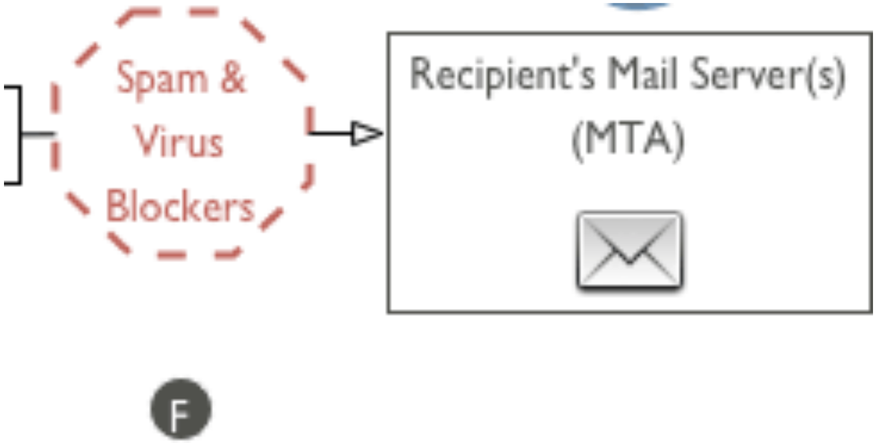
- Email **clears the queue, enters the Internet network cloud, where it is routed along a host-to-host** chain of servers
- The sending MTA **handles all aspects of mail delivery until the message has been either accepted or rejected** by the receiving MTA
- Each MTA needs to **"stop and ask directions" from the DNS in order to identify the next MTA in the delivery chain**
- Exact route **depends partly on server availability and mostly on which MTA can be found to accept email** for the domain specified in the address
- **ABUSE**: *Some spammers specify any part of the path, deliberately routing their message through a series of relay servers in an attempt to obscure the true origin of the message.*

# DNS resolution and transfer process

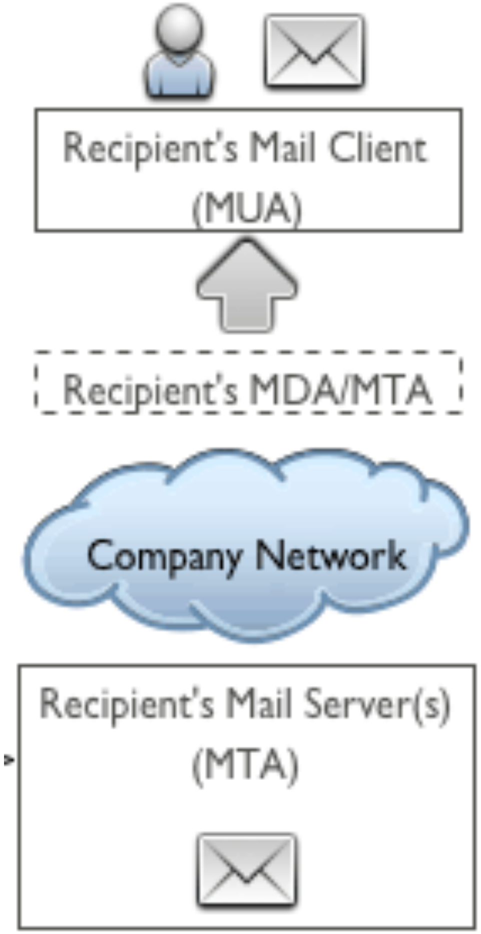
- **To find the recipient's IP address and mailbox**, the MTA must **drill down through the DNS system**, which consists of a set of servers distributed across the Internet beginning with the root nameservers
  - root servers refer requests for a given domain to the root nameservers that handle requests for that tld
    - ***MTA can bypass this step because it has already knows which domain nameservers handle requests for these .tlds  e.g. telecom.ma***
  - asks the appropriate DNS server which Mail Exchange (MX) servers have knowledge of the subdomain or local host in the email address
  - DNS server responds with an MX record: a prioritized list of MX servers for this domain
  - To the DNS server, the server that accepts messages is an MX server. When is transferring messages, it is called an MTA.
  - MTA contacts the MX servers on the MX record in order of priority until it finds the designated host for that address domain
  - **sending MTA asks if the host accepts messages for the recipient's username at that domain (i.e., username@domain.tld) and transfers the message**

# Firewalls, spam, and virus filters

- An email encountering a firewall may be **tested by spam and virus filters** before it is allowed to pass inside the firewall
- filters test to see **if the message qualifies as spam or malware**
- If the message contains **malware, the file is usually quarantined and the sender is notified**
- If the message is identified as spam, **it will probably be deleted without notifying the sender**.



# Delivery



- If the message makes it past  the filters:
  - The MTA calls a local MDA to deliver the mail to the correct mailbox, where it will sit until it is retrieved by the recipient's MUA

# Bibliography: RFCs

- RFC 2821, 2822,
- RFC 1122, 1123: prerequisites for machines connected to the Internet
- RFC 1651: extensions to the SMTP protocol
- RFC 1653: SIZE extension
- RFC 1830: transporting large messages containing binaries
- MIME RFCs...

Postfix MTA

# EMAIL

# Short History

- Originally developed in the late 90s at IBM by Wietse Venema, author of security software (SATAN, TCPwrappers, …), as ”IBM Secure Mailer”
- Place under an Open Source license, and renamed ”Postfix”
- Intended as a replacement for then insecure mail systems, such as Sendmail

# Design goals

- Safety
- Robustness
- Performance
- Modularity
- Compatibility

# Safety

- Postfix makes it very hard to lose mails – many checks to ensure that mail has been written to disk or delivered
- Back off mechanisms in case of repeated failure

# Security

- Collection of daemons working together
- Doesn't use environment for communication
- Very paranoid about input checking, all allocation is dynamic (avoiding buffer overflows)
- chroot support out of the box for almost all processes & daemons
- No data is *ever* exchanged directly between processes – all is done via IPC, and files on disk
- Conservative resource usage

# Performance

- Designed to be fast from the ground up
- Also behaves well with neighbors, doesn't flood them with mail, and instead uses a throughput adaptation
- Will not block delivery for a message if one recipient domain fails

# Modular

- One program, one function
- All programs controlled from ”master.cf”
- Many small programs working together, with limited privileges
- Compatible with Sendmail's /etc/aliases and .forward conventions

# Features

- Virtual domains – domains and users are completely independent of system (UNIX) users
- Aliases – sendmail compatible
- Rewriting – senders, recipients, globally
- RBL support (Realtime Blackhole Lists) support
- Content filtering using pipes, SMTP or milter
- Support for arbitrary mail manipulation with policy services (custom programs talking to postfix)

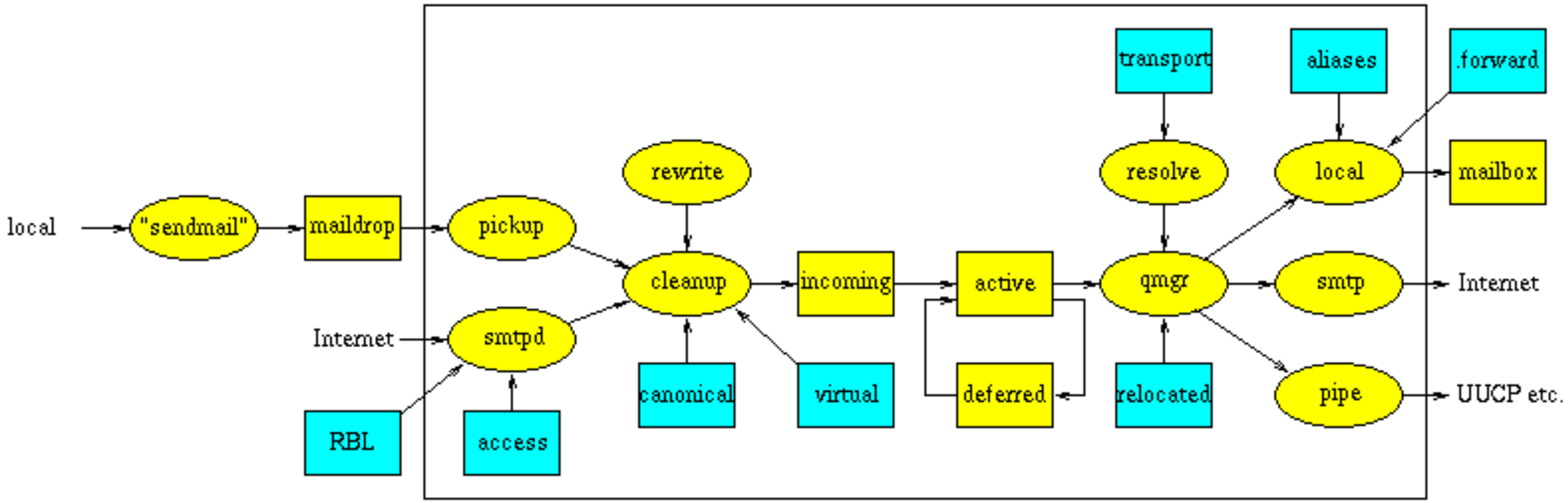
# Features

- Restriction classes
    - Conditional filtering
- Sender or recipient address verification (test email addresses before accepting mail from them)
- TLS support

# Core concept: maps

- In postfix, everything is looked up in a map (table)
- Maps can be in many formats or use many data sources:
  - hash/btree
  - regexp/PCRE
  - CIDR
  - NIS
  - LDAP, *SQL (user defined queries)

# Architecture



# Basic Postfix configuration

Two primary configuration files

- main.cf
  - Main configuration file where all the subsystems are configured (smtp, smtpd, cleanup, routing, …)
- master.cf
  - File controlling how the ”master” process of postfix will launch all the necessary postfix daemons to perform mail routing, on-demand

# Other configuration files

- Reside in ”maps” mentioned earlier
- Tables containing values and conditions, referred to from main.cf, controlling all aspects such as:
  - Virtual and local domains
  - Routing rules
  - Access control
  - Rewriting
  - ...

# Configuration: postconf command

- postconf – used to view and edit configuration parameters
  - For changing the configuration, it is usually done vi editing ”main.cf” directly

# Some basic main.cf

```
# what domains do I accept mail for (user@...)
mydestination=   $myhostname, localhost, \
   hervey.ws.nsrc.org

# who do I send mail as ?
myorigin  =         $mydomain

# what clients do I consider local (and trust them)
mynetworks =     127.0.0.0/8 192.168.1.0/24

# Send all outgoing mail to this server
relayhost =         mail.example.com
# Aliases
alias_maps = hash:/etc/aliases
```

# Some basic main.cf (cont'd)

- **in the file /etc/aliases:**

```
root:          sysadm
phil:          regnauld@nsrc.org
```

# Virtual domains

- Allows having multiple mail domains on one machine
- They can be *completely* different than your own hostname/domainname
- Example:
  - **in main.cf:**

    ```
    virtual_maps = $cf/virtual-domains
    ```

  - **in virtual-domains file:**

    ```
    superdomain.com       VIRTUAL
    phil@superdomain.com  phil@nsrc.org, pr@eu.org
    @superdmain.com       sysadm@localhost
    ```

# Controlling postfix

- postfix start – start the postfix system
- postfix stop – stop the postfix system
- postfix check – verify the configuration
- newaliases – rebuild the local aliases
- mailq – show the mails in the queue currently being processed

# Bibliography: References

- Links
  - http://www.postfix.org/
  - http://www.ijs.si/software/amavisd/
- Books:
  - "Postfix", Richard Blum, ed. Sams (1st ed. May 15, 2001), 624 p., ISBN: 0672321149
  - "The book of Postfix", Ralf Hildebrandt, Patrick Koetter ed. No Starch Press (October 2003), 328 p., ISBN: 1593270011

Configuration and Basic Setup:

*(specific to our installation environment)*

# POSTFIX

# installing

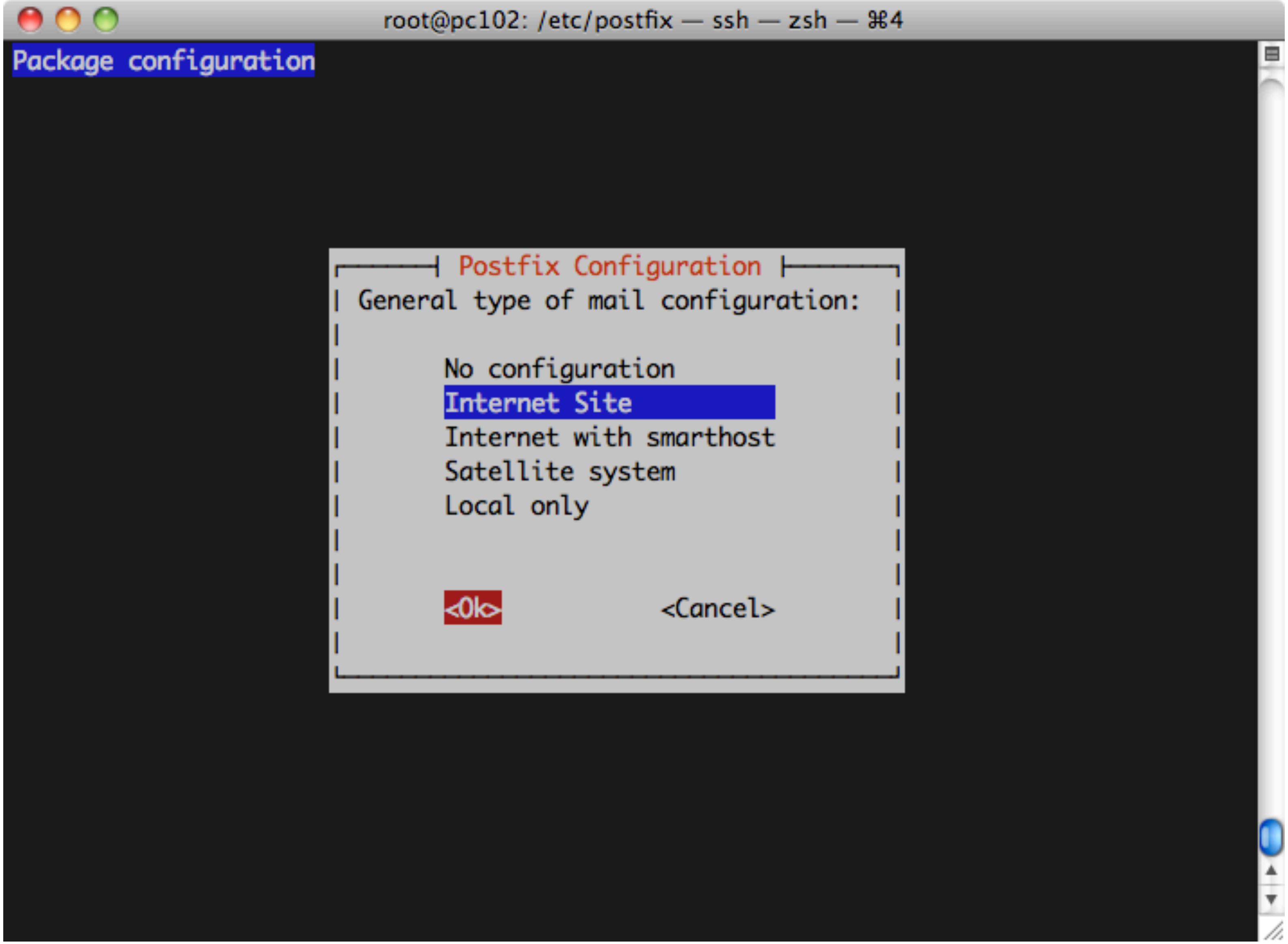
- It is already installed, otherwise you'd have to do:

```
# apt-get install postfix
```

- In our case we need to do:

```
# dpkg-reconfigure -phigh postfix
```

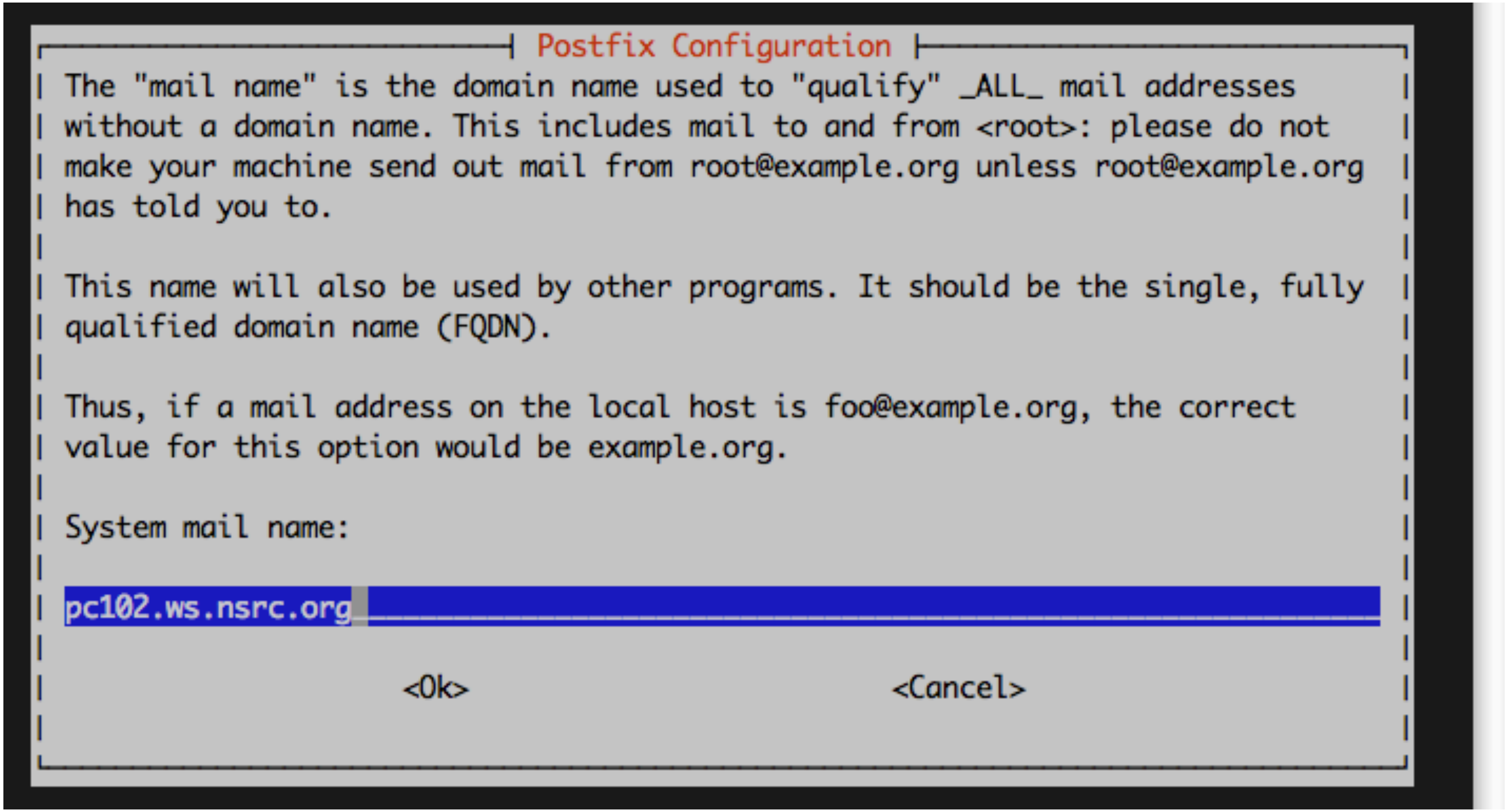
# Type of Mail configuration



```
Package configuration

┌──────┤ Postfix Configuration ├───────┐
│ General type of mail configuration:  │
│                                      │
│         No configuration             │
│         Internet Site                │
│         Internet with smarthost      │
│         Satellite system             │
│         Local only                   │
│                                      │
│                                      │
│         <Ok>           <Cancel>      │
│                                      │
└──────────────────────────────────────┘
```

# FQDN



```
┌──────────────────────────┤ Postfix Configuration ├──────────────────────────┐
│ The "mail name" is the domain name used to "qualify" _ALL_ mail addresses    │
│ without a domain name. This includes mail to and from <root>: please do not  │
│ make your machine send out mail from root@example.org unless root@example.org │
│ has told you to.                                                             │
│                                                                              │
│ This name will also be used by other programs. It should be the single, fully │
│ qualified domain name (FQDN).                                                │
│                                                                              │
│ Thus, if a mail address on the local host is foo@example.org, the correct    │
│ value for this option would be example.org.                                  │
│                                                                              │
│ System mail name:                                                            │
│                                                                              │
│ pc102.ws.nsrc.org___________________________________________________________ │
│                                                                              │
│                <Ok>                              <Cancel>                    │
│                                                                              │
└──────────────────────────────────────────────────────────────────────────────┘
```

# myhostname

- our virtual hosting solution will create a hostname of gold.ws.nsrc.org. we need to change this as well as set the ‘destinations’ this host accepts mail for.
- Edit /etc/postfix/main.cf and set:

```
myhostname = pc31.ws.nsrc.org
mydestination = localhost, $myhostname \
    hervey.ws.nsrc.org
```

- Restart postfix:

```
# service postfix restart
```

# Install a basic MUA

```
# apt-get install alpine
```

```
$ alpine
```

(command keys in alpine are case insensitive). Press ‘e’ to exit the counter then follow the menu ‘i’ to go to the inbox, etc.

Try sending an email to sysadm@pcX.ws.nsrc.org as well as any other domain that should be working in class.

Since we did not delegate from nsrc.org mail to yahoo.com may bounce but should work to a gmail.com address. Returning mail won’t find its way here.

Extras

# EMAIL

# Bits and pieces we can’t cover

- Adding SSL to SMTP as well as SMTP AUTH
- POP3
- IMAP
- Webmail
- SSL to POP3 and IMAP
- Configuration of other MUAs