Network Startup Resource Center

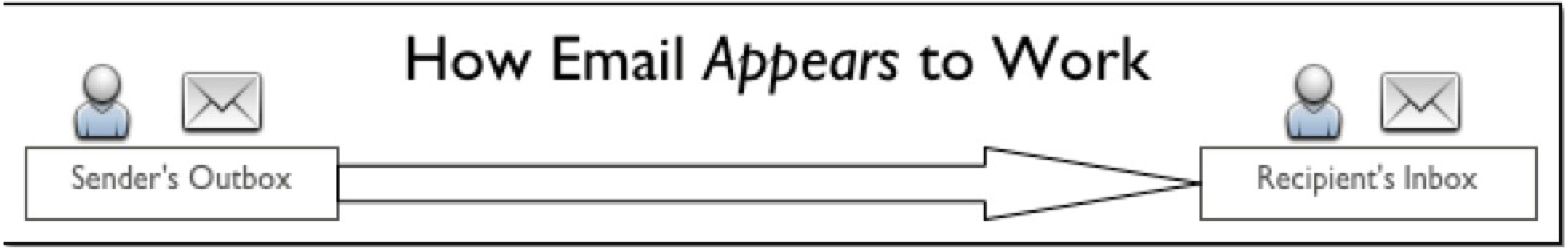
E-Ma

SMTP, POP, and IMAP

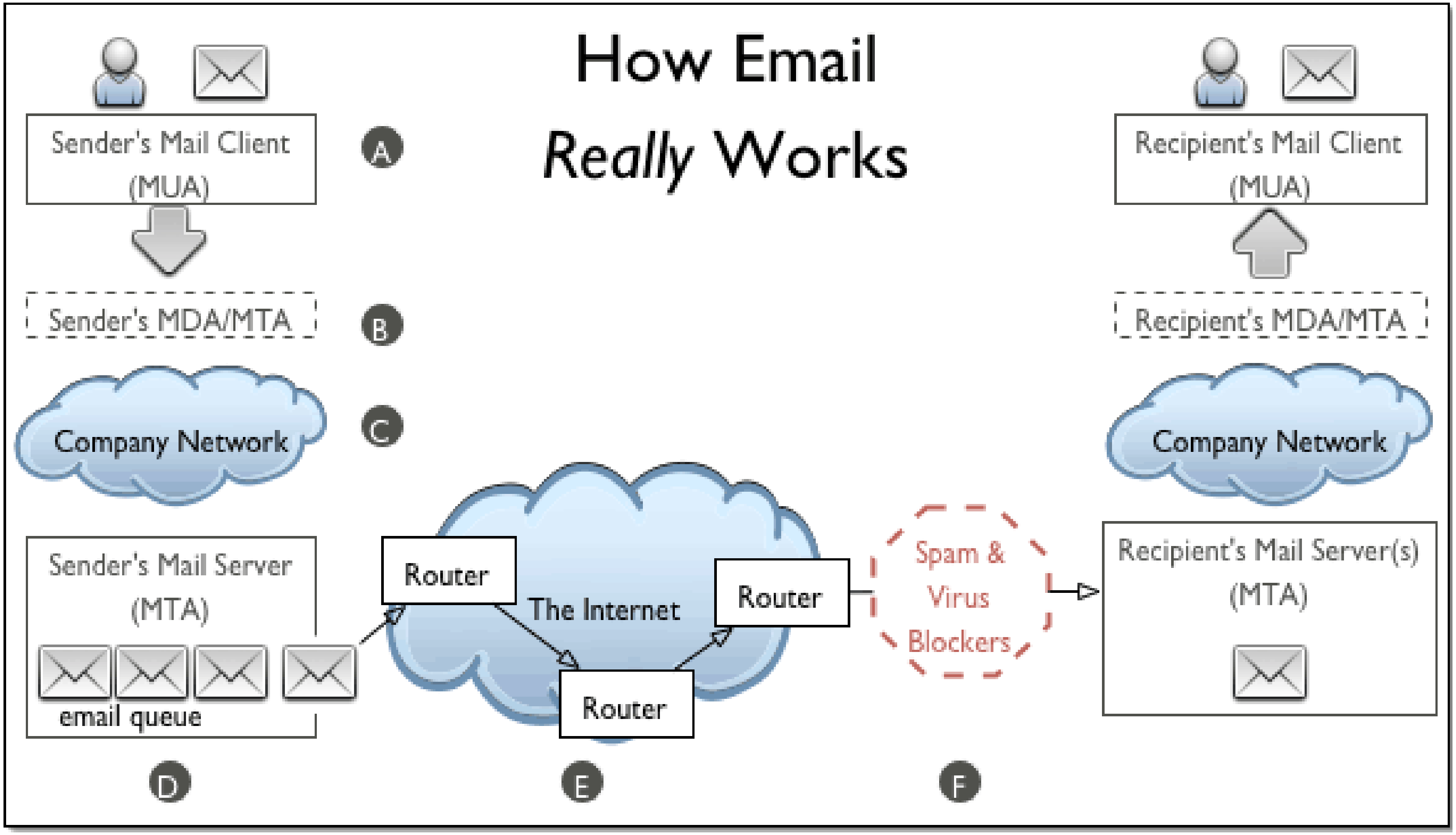
Scope

- 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

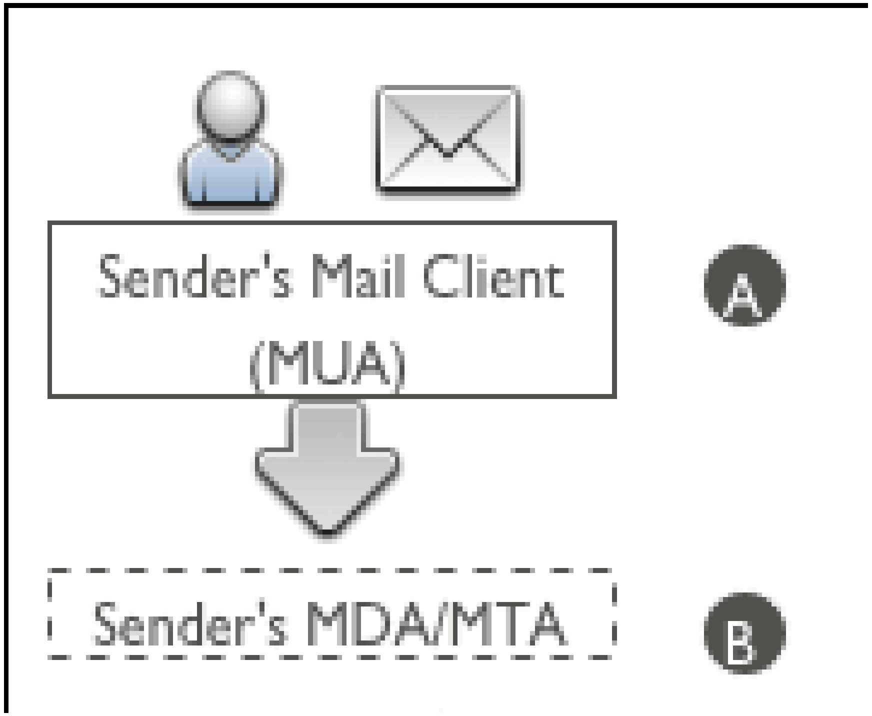


How Email Really Works



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- Now superseded by RFC 2822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

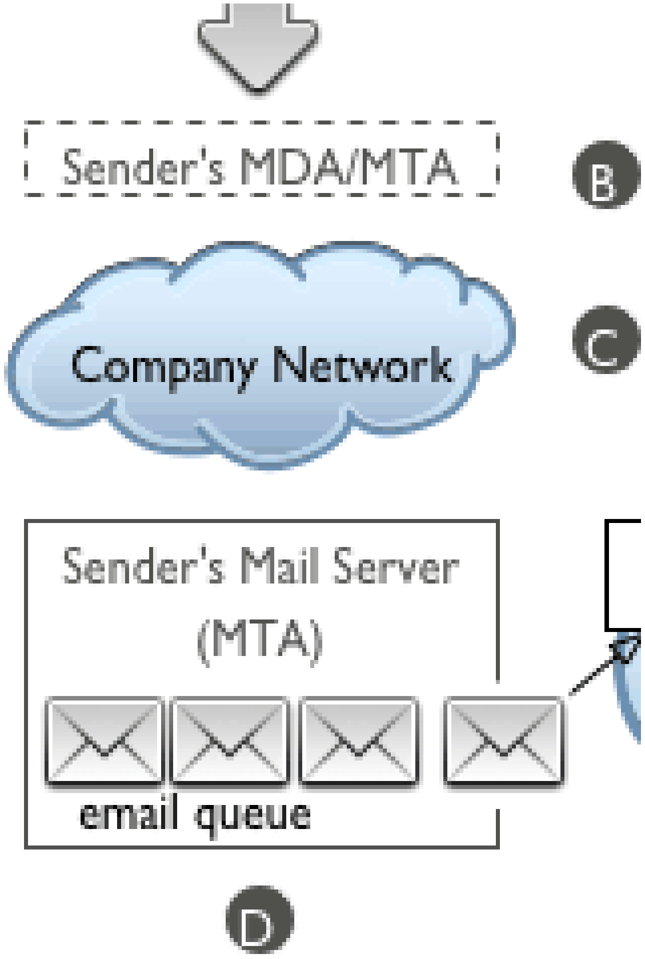
From: Philip Hazel <ph10@cus.cam.ac.uk>
To: Julius Caesar <julius@ancient-rome.net>
cc: Mark Anthony <MarkA@cleo.co.uk>
Subject: How Internet mail works

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 **e**smtp
(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

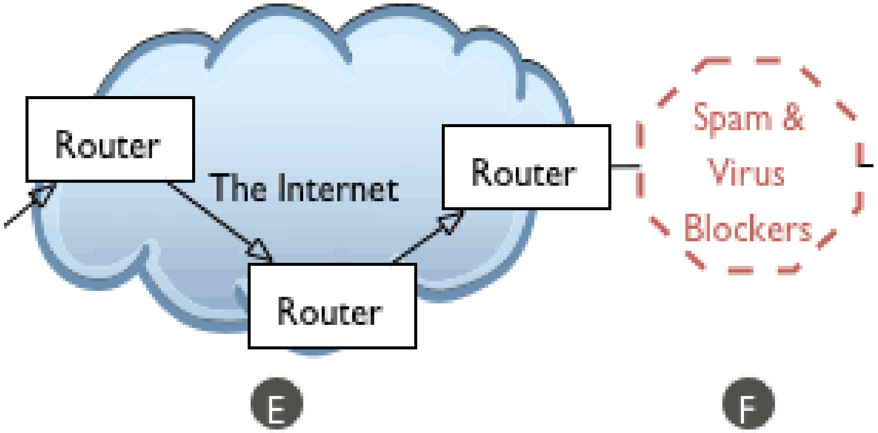
ESMTP

```
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>
...
```

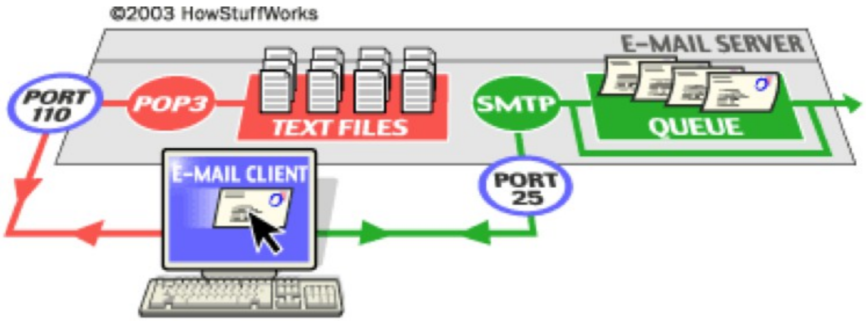
- Defined in RFC 1869
  - Adds new functionality
    - Transport of 8bit MIME messages
    - Maximum message size limit
    - Function limitation (EXPN, VRFY, ...)
    - Other extensions (pipelining, private extensions)
- The welcome message for ESMTP is EHLO (instead of HELO). In case of a negative 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

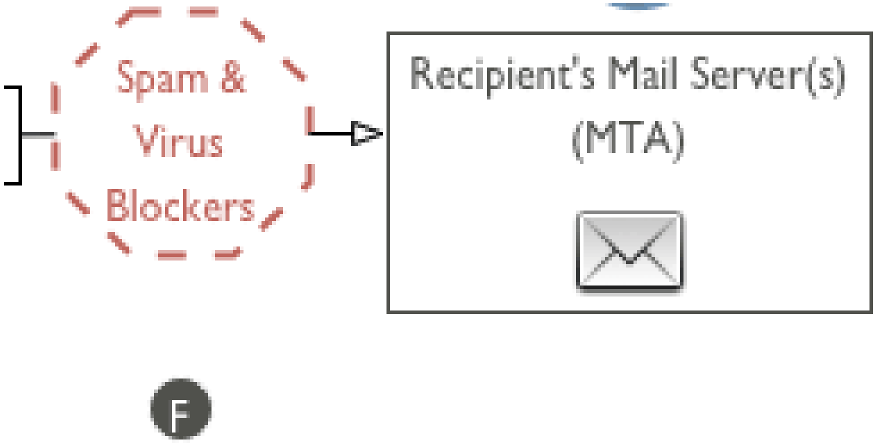
- Email **clears the queue, enters the Internet network cloud, where it is routed along a host-to-host** chain of servers
- The sending MTA **handles all aspects of mail delivery until the message has been either accepted or rejected** by the receiving MTA
- Each MTA needs to **"stop and ask directions" 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

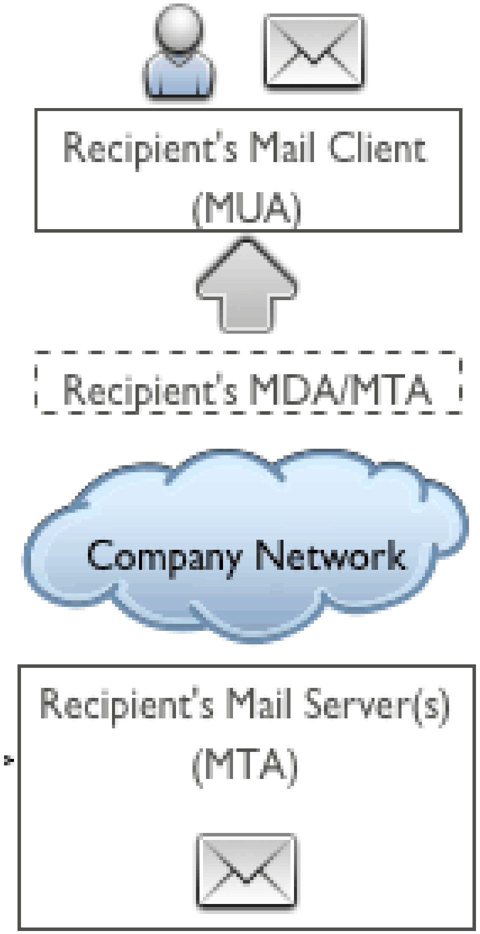
- **To find the recipient's IP address and mailbox**, the MTA must **drill down through the DNS system**, which consists of a set of servers distributed across the Internet beginning with the root nameservers
  - root servers refer requests for a given domain to the root nameservers that handle requests 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 1869: extensions to the SMTP protocol
- RFC 1653: SIZE extension
- RFC 1830: transporting large messages containing binaries
- MIME RFCs...

Network Startup Resource Center

Exim MTA

EMAIL