Electronic Mail

Prof. Indranil Sen Gupta

Professor, Dept. of Computer Science & Engineering

Indian Institute of Technology

Kharagpur

Introduction

- **Most heavily used application on the Internet.**

- **Simple Mail Transfer Protocol (SMTP)**
    - **Uses TCP/IP**
    - **Delivery of simple text messages**

- **Multi-purpose Internet Mail Extension (MIME)**
    - **Delivery of other types of data**
   - **Voice, images, video clips**

Simple Mail Transfer Protocol (SMTP)

- **Based on RFC 821.**
- **Not concerned with format of messages or data.**
  - Transmits simple text messages only.
- **SMTP uses information written on envelope of mail.**
  - Message header
- **Does not look at contents.**
  - Message body
- **Except:**
  - Standardize message character set to 7 bit ASCII.
  - Add log information to start-of-message.
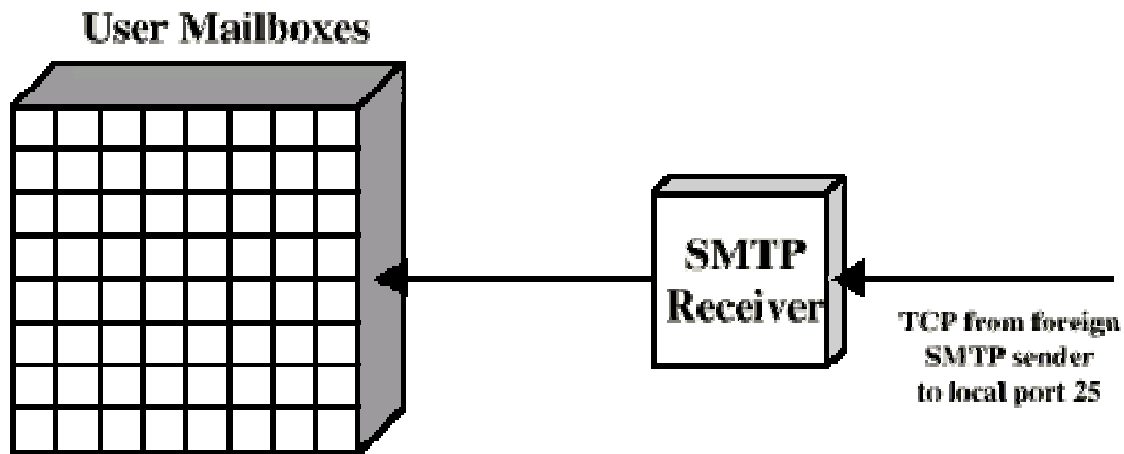   - Shows path taken.

Basic Operation

- **Mail created by user agent program (mail client).**
  - **Message consists of:**
    - **Header containing recipient's address and other information.**
    - **Body containing user data.**

- **Messages queued and sent as input to SMTP sender program.**
  - **Typically a server process (daemon on UNIX).**

SMTP Mail Flow
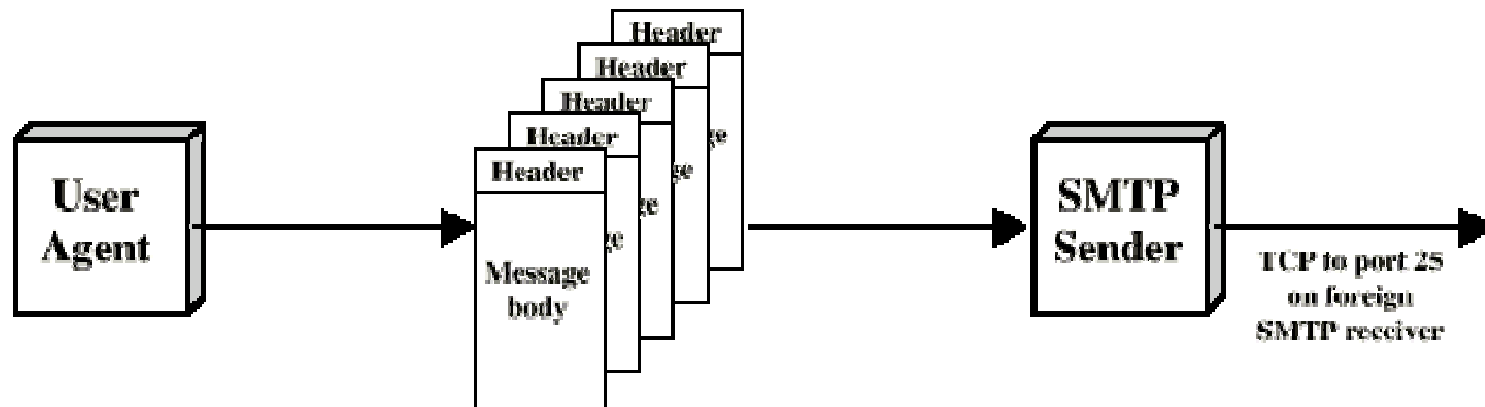
(a) Outgoing Mail

(b) Incoming Mail

Mail Message Contents

- **Each queued message has:**
  - **Message text**
    - **RFC 822 header with message envelope and list of recipients.**
    - **Message body, composed by user.**
  - **A list of mail destinations**
    - **Derived by user agent / SMTP server from header.**
    - **May be listed in header.**
    - **May require expansion of mailing lists.**

SMTP Sender

- **Takes message from queue.**

- **Transmits to proper destination host.**
  - **Via SMTP transaction.**
  - **Over one or more TCP connections to port 25.**

- **When delivery complete, sender deletes destination from list for that message.**

- **When all destinations processed, message is deleted.**

Possible Errors

- **Host unreachable**
- **Host out of operation**
- **TCP connection fail during transfer**
- **Sender can re-queue mail**
  - **Give up after a period**
- **Faulty destination address**
  - **User error**
  - **Target user address has changed**
  - **Redirect if possible**
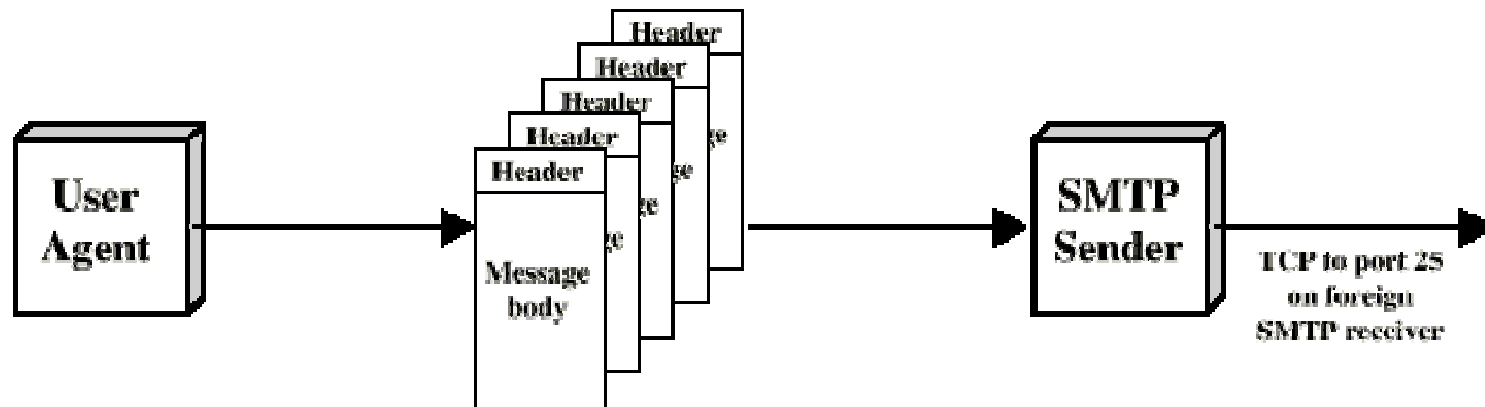 - **Inform user if not**

SMTP Receiver

- **Accepts arriving message.**
- **Places in user mailbox or copies to outgoing queue for forwarding.**
- **Receiver must:**
  - **Verify local mail destinations.**
  - **Deal with errors**
    - **Transmission**
    - **Lack of disk space**
- **Sender responsible for message until receiver confirm complete transfer.**
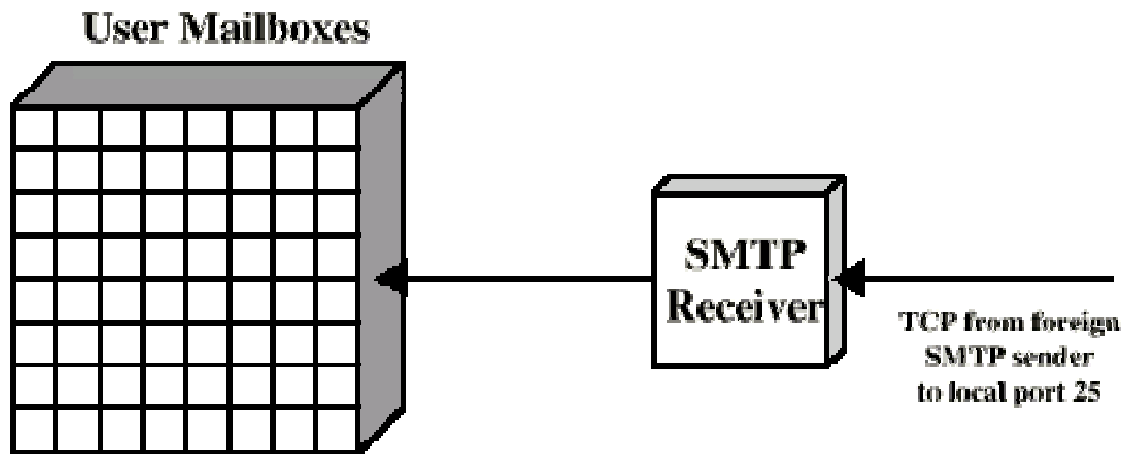 - **Indicates mail has arrived at host, not user.**

SMTP Forwarding

- **Mostly direct transfer from sender host to receiver host.**

- **May go through intermediate machine via forwarding capability.**
  - Sender can specify route.

SMTP Mail Flow

Header
Header
Header
Header
Header

Message
body

User
Agent

SMTP
Sender

TCP to port 25
on foreign
SMTP receiver

(a) Outgoing Mail

User Mailboxes

SMTP
Receiver

TCP from foreign
SMTP sender
to local port 25

(b) Incoming Mail

SMTP System Overview

- **Commands and responses between sender and receiver.**

- **Initiative with sender.**
  - **Establishes TCP connection.**

- **Sender sends commands to receiver.**
  - **e.g.   HELO <domain><CRLF>**

- **Each command generates exactly one reply.**
  - **e.g. 250 requested mail action ok; completed.**

SMTP Replies

- **Leading digit indicates category.**
  - **Positive completion reply (2xx)**
  - **Positive intermediate reply (3xx)**
  - **Transient negative completion reply (4xx)**
  - **Permanent negative completion reply (5xx)**

Operation Phases

- **Connection setup**
- **Exchange of command-response pairs**
- **Connection termination**

Connection Setup

- **Sender opens TCP connection with receiver.**
- **Once connected, receiver identifies itself.**
  - **220 <domain> service ready**
- **Sender identifies itself.**
  - **HELO**
- **Receiver accepts sender's identification.**
  - **250 OK**
- **If mail service not available, the second step above becomes:**
  - **421 service not available**

Mail Transfer

- **Sender may send one or more messages to receiver.**
- **MAIL command identifies originator.**
  - Gives reverse path to be used for error reporting.
  - Receiver returns 250 OK or appropriate fail/error message.
- **One or more RCPT commands identifies recipients for the message.**
  - Separate reply for each recipient.
- **DATA command transfers message text.**
  - End of message indicated by line containing just period (.)

Closing Connection

- **Two steps:**
  - **Sender sends QUIT and waits for reply.**
  - **Then initiate TCP close operation.**

- **Receiver initiates TCP close after sending reply to QUIT.**

An Example SMTP Session

S: 220 hotmail.com Simple Mail Transfer Service Ready

C: HELO yahoo.com

S: 250 hotmail.com

C: MAIL FROM: <isg@yahoo.com>

S: 250 OK

C: RCPT TO: <myfriend@hotmail.com>

S: 250 OK

C: RCPT TO: <somebody@hotmail.com>

S: 250 OK

C: DATA

S: 354 Start mail input; end with (.)

C: … actual contents of the message …

C: ....

C: ....

C: (.)

S: 250 OK

C: QUIT

S: 221 hotmail.com Service closing transmission channel

Mail Access Protocols

- **Two mail access protocols are widely used:**

  1. **Post Office Protocol, version 3 (POP3)**

  2. **Internet Mail Access Protocol version 4 (IMAP4).**

POP3

- **The client POP3 software is installed on the recipient machine, and the server POP3 software installed on mail server.**
  - The client (user agent) opens a connection with the server on TCP/110.
  - Sends user name and password.
  - Can access the mails, one by one.
  - Two modes:
    - Delete mode – mails deleted as they are read
    - Keep mode – mails remain in the mailbox

IMAP4

- **Provides the following extra features:**
  - **A user can check the email header before downloading.**
  - **A user can search the contents of the email for a specific string prior to downloading.**
  - **A user can create, delete, or rename mailboxes on the mail server.**
  - **A user can create a hierarchy of mailboxes in a folder for email storage.**

Multipurpose Internet Mail Extension (MIME)

- **SMTP can not transmit nontext / executables.**
  - Uuencode and other schemes are available.
    - Not standardized.

- **Cannot transmit text including international characters (e.g. â, å, ä, è, é, ê, ë).**
  - Need 8 bit ASCII.

- **Servers may reject mail over certain size.**

- **Some SMTP implementations do not adhere to standard.**
  - CRLF, truncate or wrap long lines, removal of white space, etc.

Overview of MIME

- **Five new message header fields:**
  - **MIME version**
  - **Content type**
  - **Content transfer encoding**
  - **Content Id**
  - **Content Description**
- **Number of *content formats* defined.**
- **Transfer encoding defined.**

Content Types

- **Text body**
- **Multipart**
  - **Mixed, Parallel, Alternative, Digest**
- **Message**
  - **RFC 822, Partial, External-body**
- **Image**
  - **jpeg, gif**

- **Video**
  - **mpeg**
- **Audio**
  - **Basic**
- **Application**
  - **Postscript**
  - **octet stream**

MIME Transfer Encodings

- **Reliable delivery across wide largest range of environments.**
- **Content transfer encoding field:**
  - **Six values**
  - **Three (7bit, 8bit, binary) no encoding done**
    - **Provide info about nature of data**
- **Quoted-printable**
  - **Data largely printable ASCII characters.**
  - **Non-printing characters represented by hex code.**
- **Base64**
  - **Maps arbitrary binary input onto printable output.**
- **X-token**
  - **Named nonstandard encoding.**

Base 64 Encoding
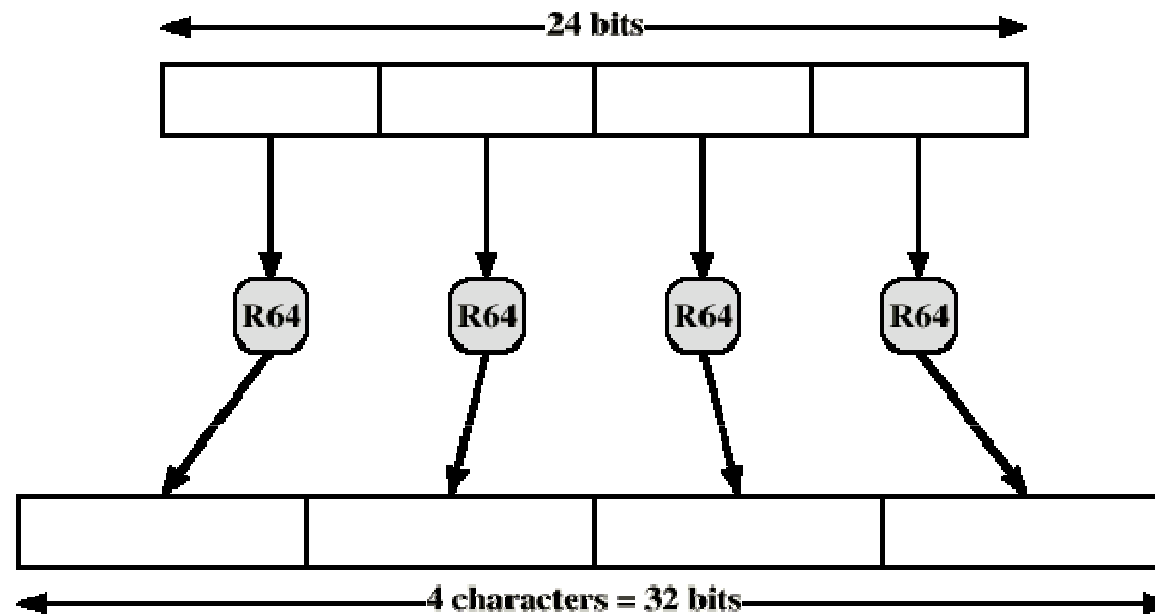
- **Expands the message by 33%.**
- **Uses the symbols A..Z,a..z,0..9,+,/**