Application Layer Contd

Internet Technologies
COMP90007

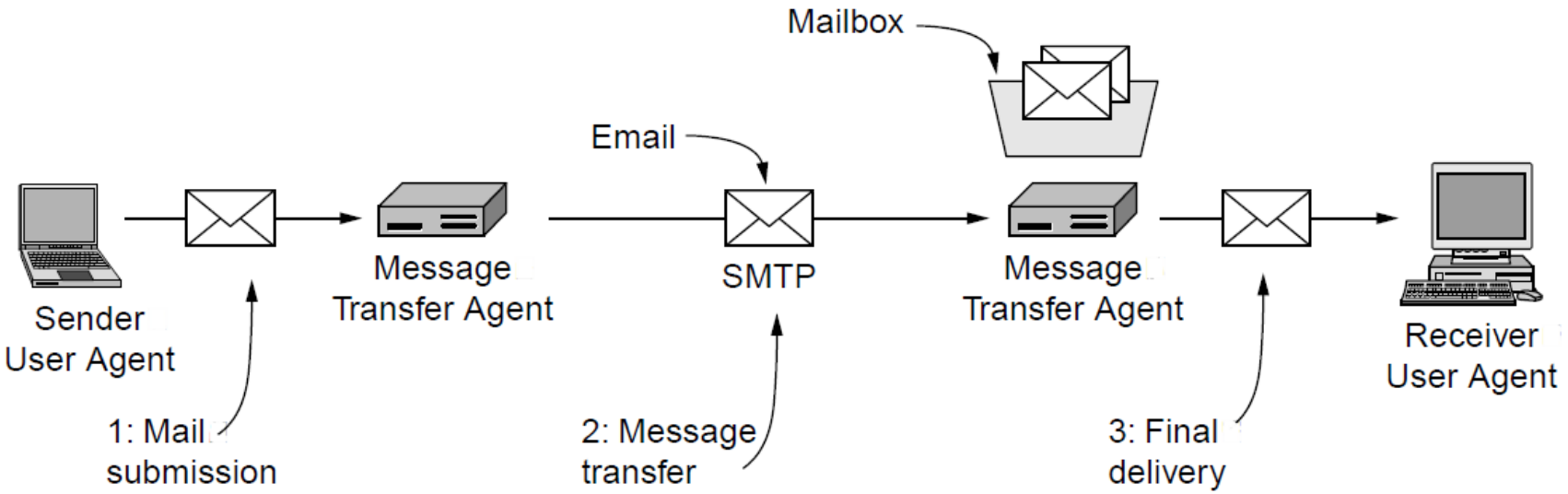
Email

- Email involves
  - User Agent: E.g., Thunderbird
  - Message Transfer Agent: Exchange
  - Message Transfer Protocols

Email Services

- Email has a long heritage (since 1960's)
- Standards for Internet-enabled email are based on 2 RFC's
  - RFC 821 (transmission)
  - RFC 822 (message format)
  - RFC 2821 and RFC 2822 (revised versions of earlier RFCs)

Architecture and Services



User agents

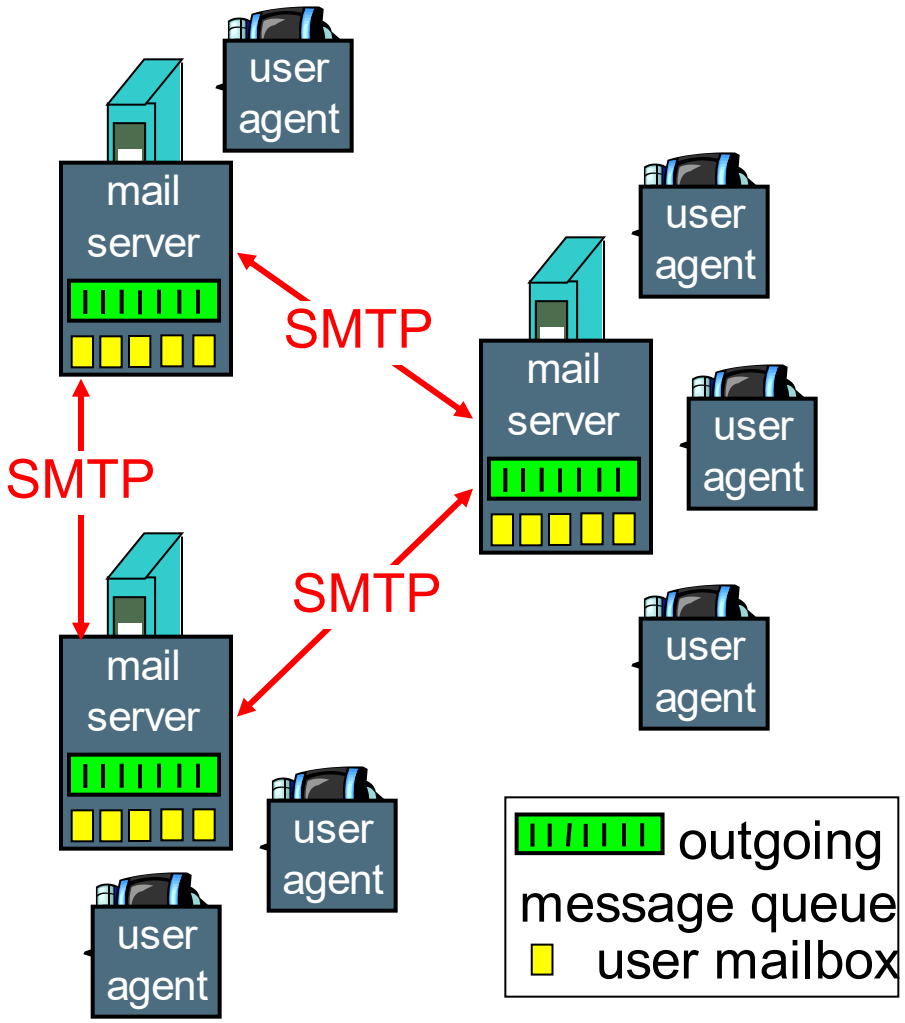
Allow user to read and send email

Message transfer agents

Transport messages from source - destination

Electronic Mail - Overview

- **SMTP (Simple Mail Transfer Protocol)** is used to ***send*** messages from the sender's
  - **mail server** to the receiver's **mail server**
  - **user agent** to the sender's **mail server**



User Agent

- Basic functions: compose, report, display, dispose
- Envelope and contents: encapsulation of transport related information
  - Envelope - destination address, priority, and security level, all of which are distinct from the message itself
  - Mail servers use the envelope for routing
- Header and body: header - user agent control info; body for human recipient
- User must provide message, destination, optional other parameters
- Addressing scheme user@dns-address

RFC 822: Message

- RFC 822 doesn't distinguish header and envelope fields
- RFC 822 allows users to invent new headers for private use but they must start with X-

Multipurpose Internet Mail Extensions (MIME) #1

- In the early days of email, messages were in English and used only simple text: **RFC822 was enough for these simple constraints**

- In time the inadequacy of RFC822 became apparent
  - Languages with **accents** (French, Spanish)
  - **Non-Latin alphabets** (eg Cyrillic)
  - **Non-alphabetic language** (eg Chinese, Japanese)
  - Messages with content other than text (**audio, images**)

- As a result, MIME (RFC 1341) was written (later updated in RFCs 2045-2049)

Multipurpose Internet Mail Extentsions (MIME) #2

- **MIME retains RFC822 format but adds** structural elements to the message body and defines encoding rules for non-ASCII messages

- MIME has 5 additional message headers:
  - MIME-Version: identifies the MIME version
  - Content-Description: human readable describing contents
  - Content-Id: unique identifier
  - Content-Transfer-Encoding: how body is wrapped for transmission
  - Content-Type: type and format of content (e.g., text/plain, html, video, etc..)

MIME Types and Subtypes

Type	Example subtypes	Description
text	plain, html, xml, css	Text in various formats
image	gif, jpeg, tiff	Pictures
audio	basic, mpeg, mp4	Sounds
video	mpeg, mp4, quicktime	Movies
model	vrml	3D model
application	octet-stream, pdf, javascript, zip	Data produced by applications
message	http, rfc822	Encapsulated message
multipart	mixed, alternative, parallel, digest	Combination of multiple types

Message Format

- Typical multipart message containing HTML and audio alternatives is given here

```
From: alice@cs.washington.edu
To: bob@ee.uwa.edu.au
MIME-Version: 1.0
Message-Id: <0704760941.AA00747@cs.washington.edu>
Content-Type: multipart/alternative; boundary=qwertyuiopasdfghjklzxcvbnm
Subject: Earth orbits sun integral number of times

This is the preamble. The user agent ignores it. Have a nice day.

--qwertyuiopasdfghjklzxcvbnm
Content-Type: text/html

<p>Happy birthday to you<br>
Happy birthday to you<br>
Happy birthday dear <b> Bob </b><br>
Happy birthday to you</p>

--qwertyuiopasdfghjklzxcvbnm
Content-Type: message/external-body;
        access-type="anon-ftp";
        site="bicycle.cs.washington.edu";
        directory="pub";
        name="birthday.snd"

content-type: audio/basic
content-transfer-encoding: base64
--qwertyuiopasdfghjklzxcvbnm--
```

Message Transfer

- Transfer
  - SMTP (Simple Message Transfer Protocol)
- Delivery
  - POP3 (Post Office Protocol 3)
    - Download to a single device
  - IMAP (Internet Message Access Protocol)
    - Designed with multiple devices in mind

SMTP

- Simple Message Transfer Protocol
- Simple ASCII protocol, operating on TCP port 25
- RFC 821: Simple Mail Transfer Protocol
- RFC 2821: Extended Simple Mail Transfer Protocol

SMTP Steps

- Basic steps SMTP:
  - User agent submits to MTA (mail transfer agent) on port 587
  - One MTA to the next MTA on port 25
  - Other protocols used for final delivery (IMAP, POP3)

IMAP

- Used for final delivery
- Internet Message Access Protocol (IMAP)
- RFC 3501 defines version 4
- User agent runs an IMAP client for this
- Protocol has command like:
  - Login, List, Copy, Create, Delete, etc
- Main difference with POP3 is mail remains on server
- Complex protocol but makes mail machine independent

POP3

- Was popular earlier
- Email is taken into the user computer
- Simpler protocol
- But ties emails to one machine
- What if your machine is lost
- What if you want to access mail from different machines
- …
- There are other vendor specific protocols for the last mile as well which we donot cover here

Webmail

- Gmail and alike
- A service run by a company server
- An interface to managing email over the Web
- Mainly it is an user interface

Spam

- Unwanted email
- Main countermeasures are
  - Filters based on email content
  - Blacklisting known spam addresses
  - Parking email from unknown sources
  - Collecting spam and creating a knowledge-base
  - Detecting mass emails
  - …