CS 352
Simple Mail Transfer Protocol

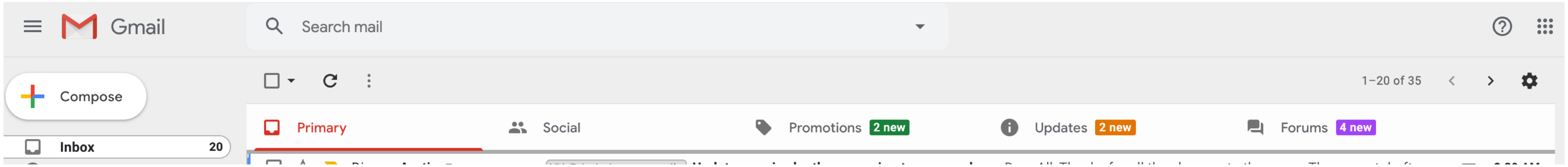
CS 352, Lecture 5.1

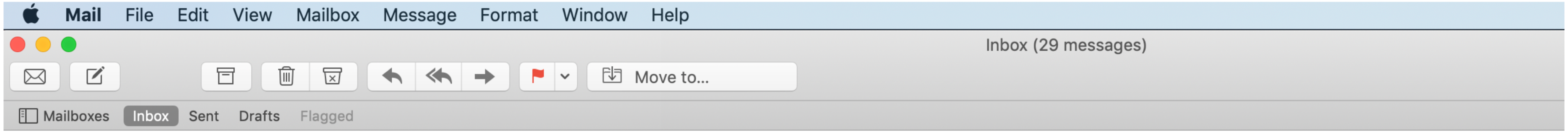
http://www.cs.rutgers.edu/~sn624/352

Srinivas Narayana

RUTGERS
UNIVERSITY | NEW BRUNSWICK

We’re all familiar with email. How does it work?

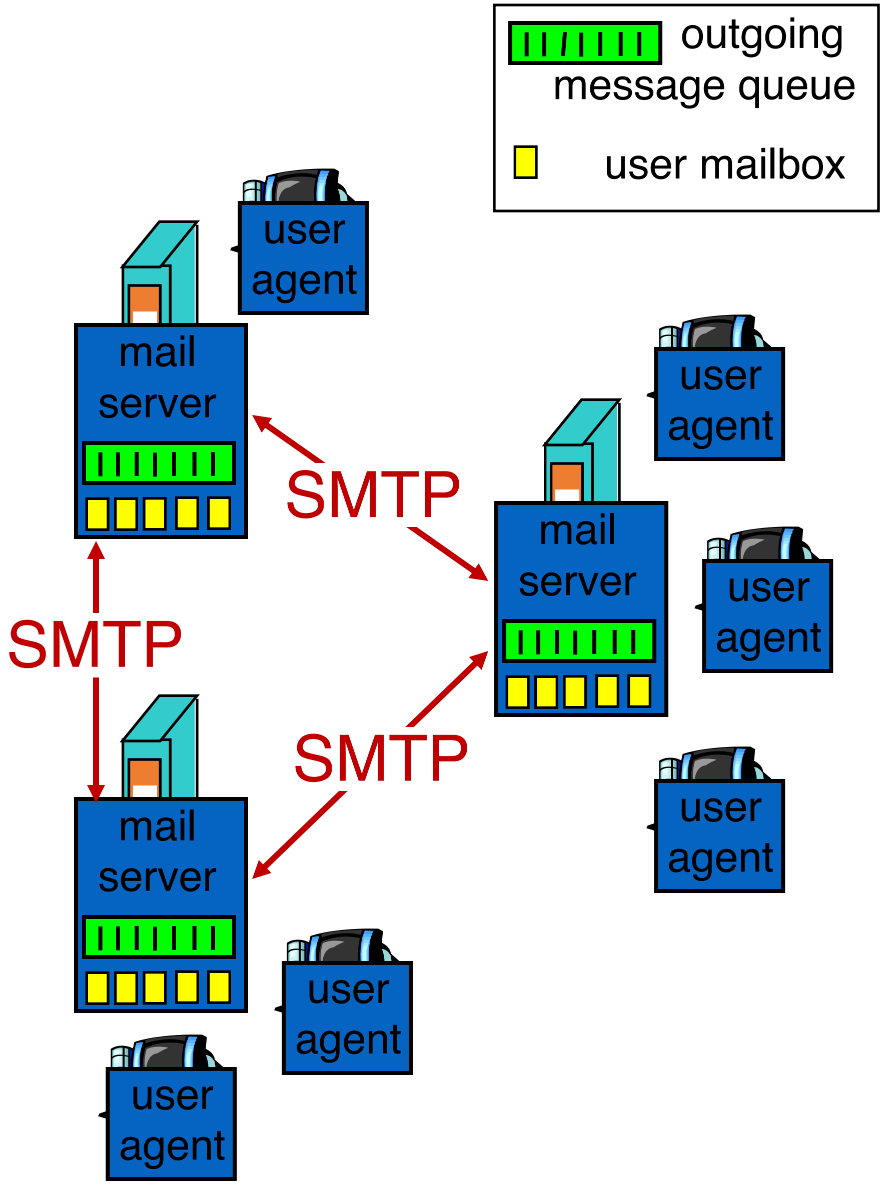



Mail File Edit View Mailbox Message Format Window Help
Inbox (29 messages)
Move to...
Mailboxes Inbox Sent Drafts Flagged

Electronic Mail

Three major components:

1. User agents
   - a.k.a. “mail reader”
   - e.g., Applemail, Outlook
   - Web-based user agents (ex: gmail)



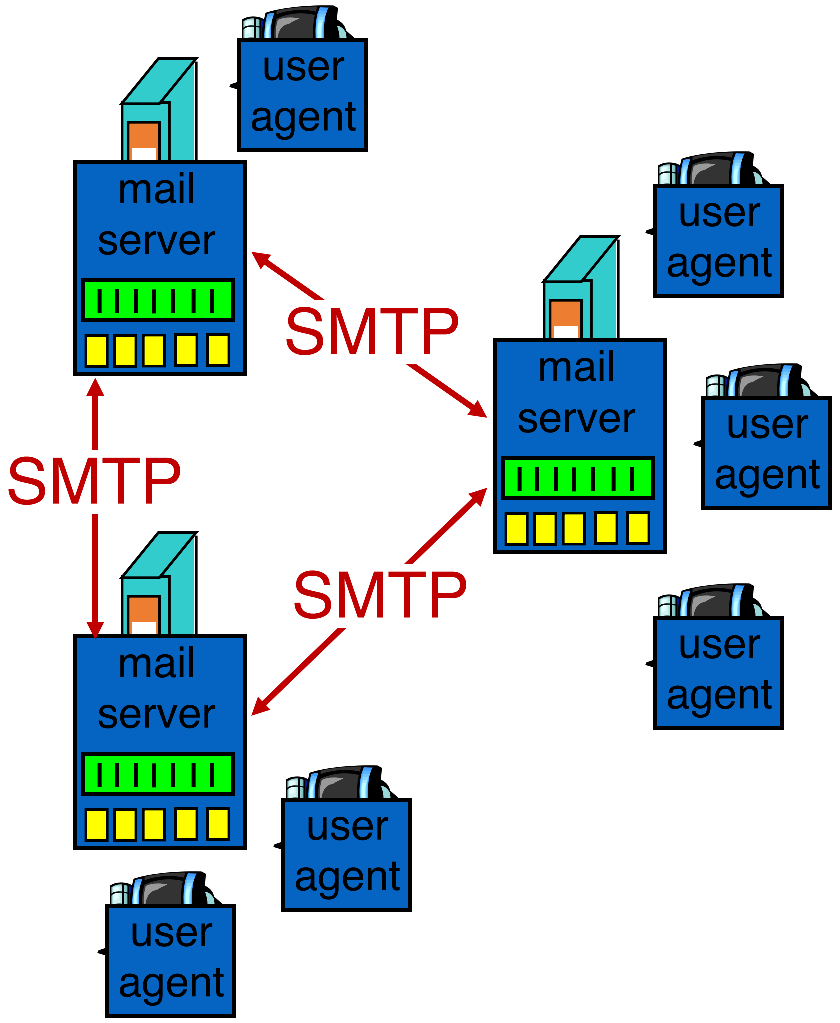
Electronic Mail: Mail servers

2. Mail Servers

- Mailbox contains incoming messages for user
- Message queue of outgoing (to be sent) mail messages
- Sender mail server makes connection to Receiver mail server
  - IP address, port 25

3. SMTP protocol

- Used to send messages
- Client: sending user agent or sending mail server
- server: receiving mail server



Scenario: Alice sends message to Bob

1) Alice (`alice@rutgers.edu`) uses UA to compose message to `bob@nyu.edu`

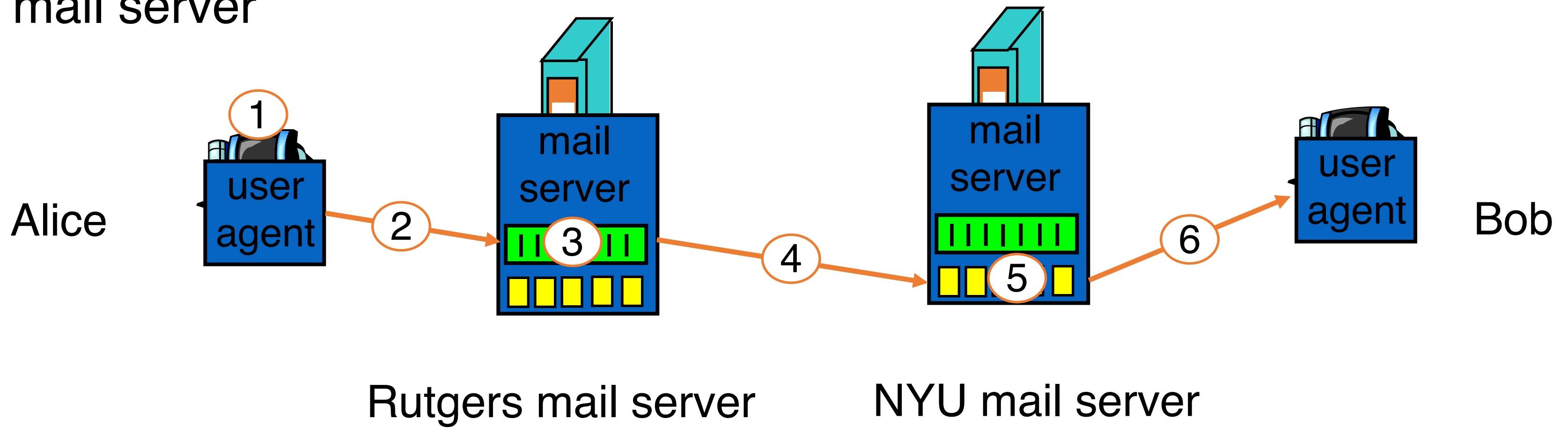
2) Alice's UA sends message to her mail server; message placed in outgoing message queue

3) Client side of SMTP opens TCP connection with Bob's mail server

4) SMTP client sends Alice's message over the TCP connection

5) Bob's mail server places the message in Bob's incoming mailbox

6) Sometime later, Bob invokes his user agent to read message



Observations on these exchanges

- Mail servers are useful “always on” endpoints
    - Receiving the email on behalf of Bob, should Bob’s machine be turned off
    - Retrying the delivery of the email to Bob on behalf of Alice, should Bob’s mail server be unavailable in the first attempt
- The same machine can act as client and server based on context
    - Rutgers’s mail server is the server when Alice sends the mail
    - It is the client when it sends mail to Bob’s mail server
- SMTP is push-heavy: info is pushed from client to server
    - Contrast to HTTP or DNS where info is pulled from the server

Sample SMTP interaction

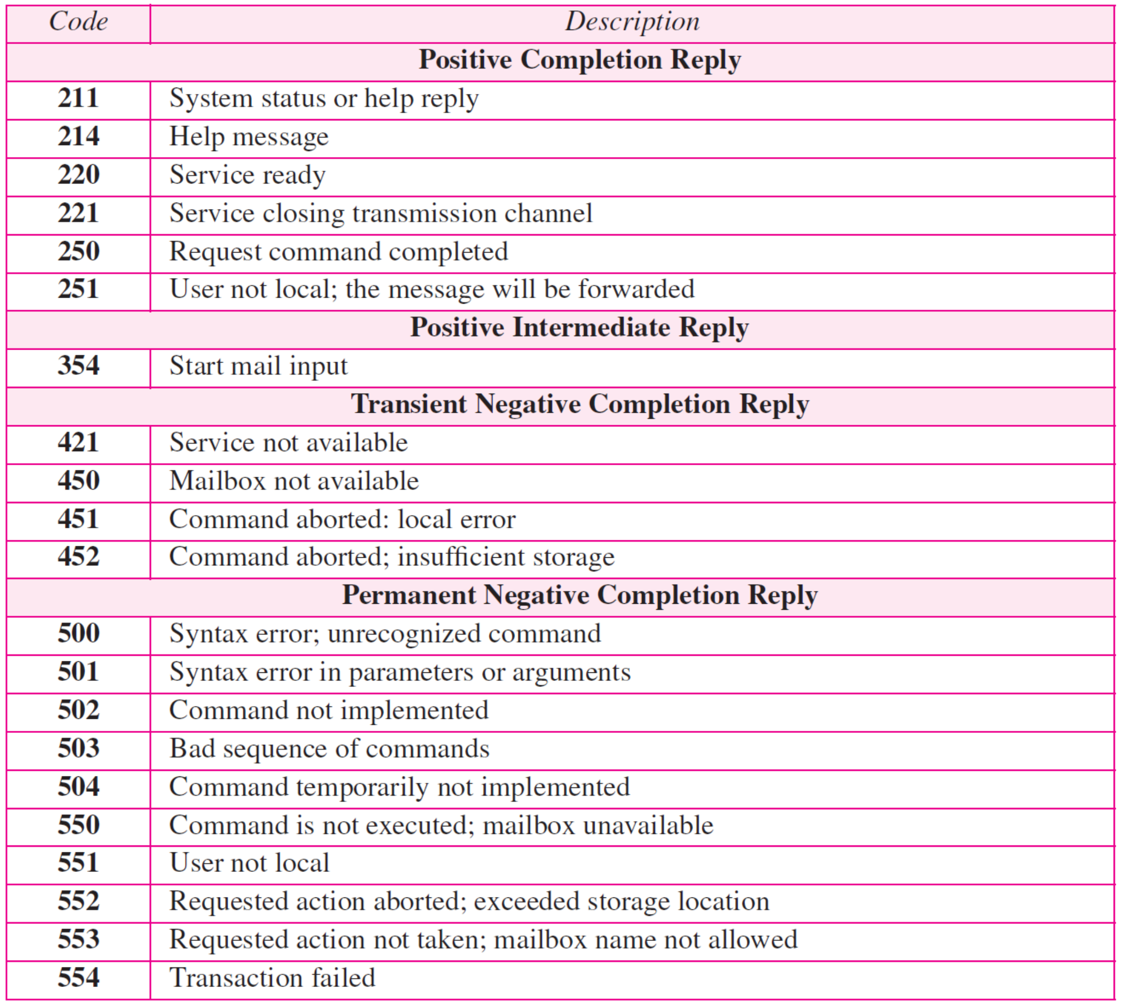
- A small demo

Sample SMTP interaction

```
                    220 hill.com SMTP service ready
HELO town.com
                    250 hill.com Hello town.com, pleased to meet you
MAIL FROM: <jack@town.com>
                    250 <jack@town.com>… Sender ok
RCPT TO: <jill@hill.com>
                    250 <jill@hill.com>… Recipient ok
DATA
                    354 Enter mail, end with “.” on a line by itself
Jill, I’m not feeling up to hiking today.  Will you please fetch me a pail of water?
.
                    250 message accepted
QUIT
                    221 hill.com closing connection
```

MAIL command response codes

Table 23.2 *Responses*



Code	*Description*
	Positive Completion Reply
211	System status or help reply
214	Help message
220	Service ready
221	Service closing transmission channel
250	Request command completed
251	User not local; the message will be forwarded
	Positive Intermediate Reply
354	Start mail input
	Transient Negative Completion Reply
421	Service not available
450	Mailbox not available
451	Command aborted: local error
452	Command aborted; insufficient storage
	Permanent Negative Completion Reply
500	Syntax error; unrecognized command
501	Syntax error in parameters or arguments
502	Command not implemented
503	Bad sequence of commands
504	Command temporarily not implemented
550	Command is not executed; mailbox unavailable
551	User not local
552	Requested action aborted; exceeded storage location
553	Requested action not taken; mailbox name not allowed
554	Transaction failed

220: Service ready
250: Request command complete
354: Start mail input
421: Service not available

Mail message (stored on server) format

SMTP: protocol for exchanging email msgs

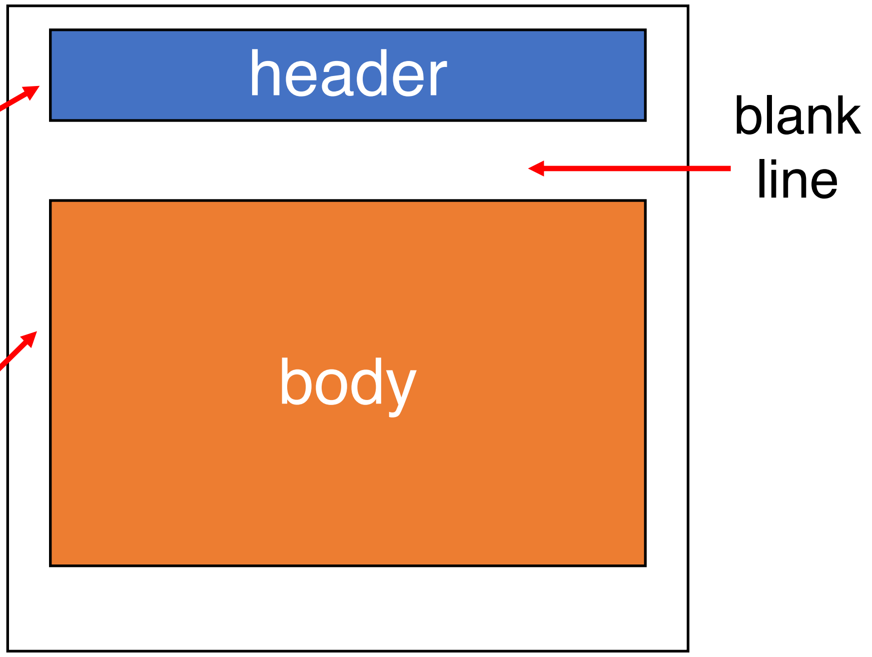
RFC 822: standard for text message format:

- header lines, e.g.,
  - To:
  - From:
  - Subject:

  different from SMTP commands!

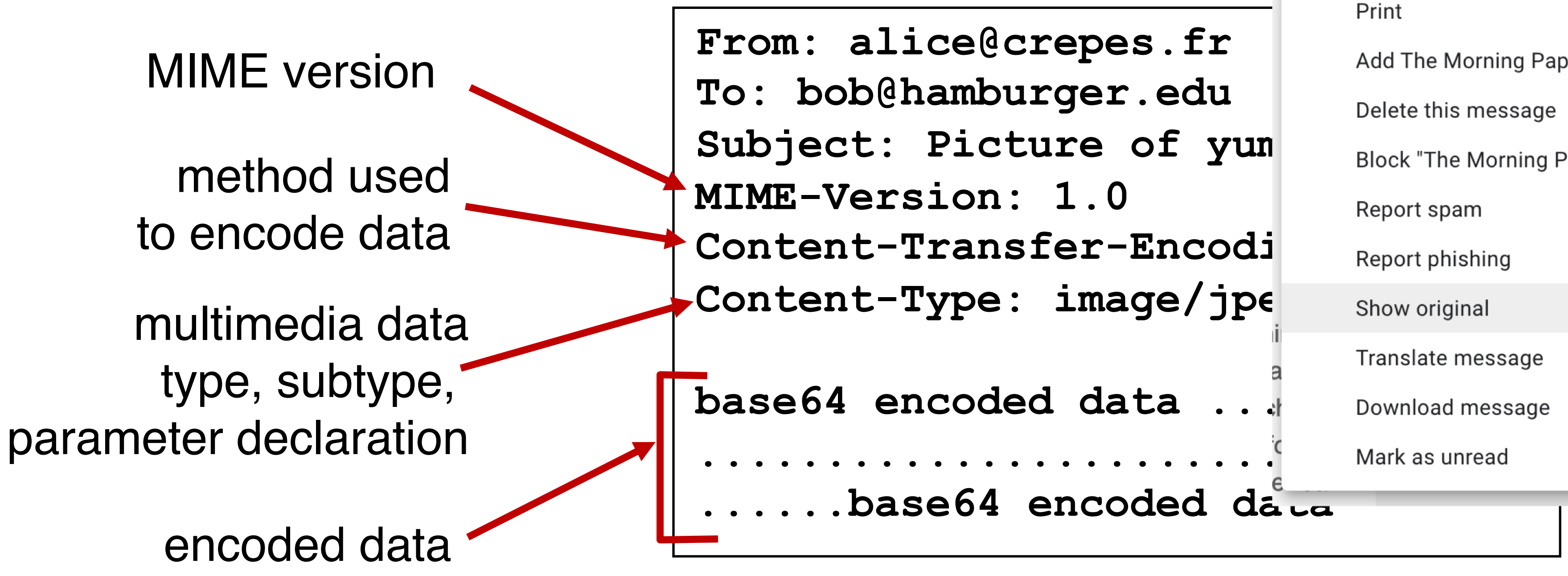
  (these would still be under "DATA")

- body
  - the "message", ASCII characters only



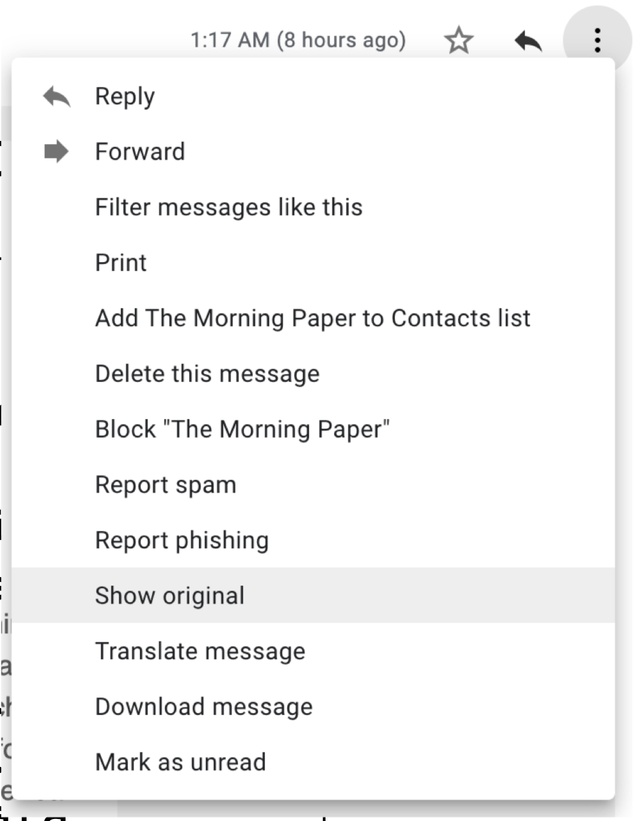
Message format: multimedia extensions

- MIME: multimedia mail extension, RFC 2045, 2056
- additional lines in msg header declare MIME content typ


MIME version
method used to encode data
multimedia data type, subtype, parameter declaration
encoded data

```
From: alice@crepes.fr
To: bob@hamburger.edu
Subject: Picture of yum
MIME-Version: 1.0
Content-Transfer-Encodi
Content-Type: image/jpe

base64 encoded data ...
.......................
......base64 encoded da
```



CS 352
Mail: Access Protocols

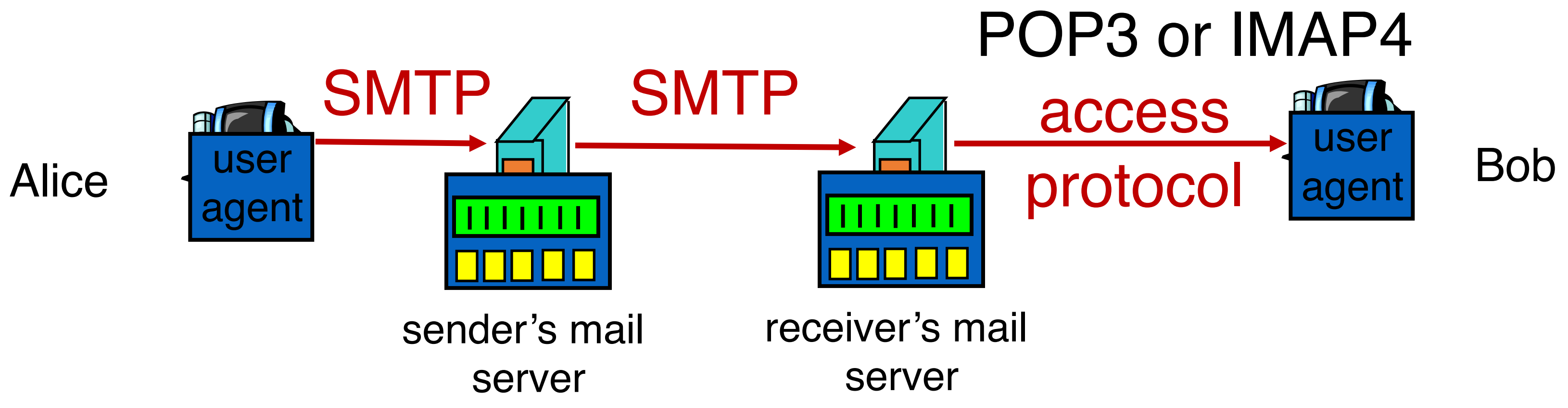
CS 352, Lecture 5.2

http://www.cs.rutgers.edu/~sn624/352

Srinivas Narayana

RUTGERS
UNIVERSITY | NEW BRUNSWICK

Mail access protocols



- SMTP: delivery/storage to receiver's server
- Mail access protocol: retrieval from server
  - POP: Post Office Protocol [RFC 1939]
    - Client connects to POP3 server on TCP port 110
  - IMAP: Internet Mail Access Protocol [RFC 1730]
    - Client connects to TCP port 143
  - HTTP: gmail, outlook, etc.

POP vs IMAP

- POP3
- Stateless server
- UA-heavy processing
- UA retrieves email from server, then typically deleted from server
- Latest changes are at the UA
- Simple protocol (list, retr, del within a POP session)

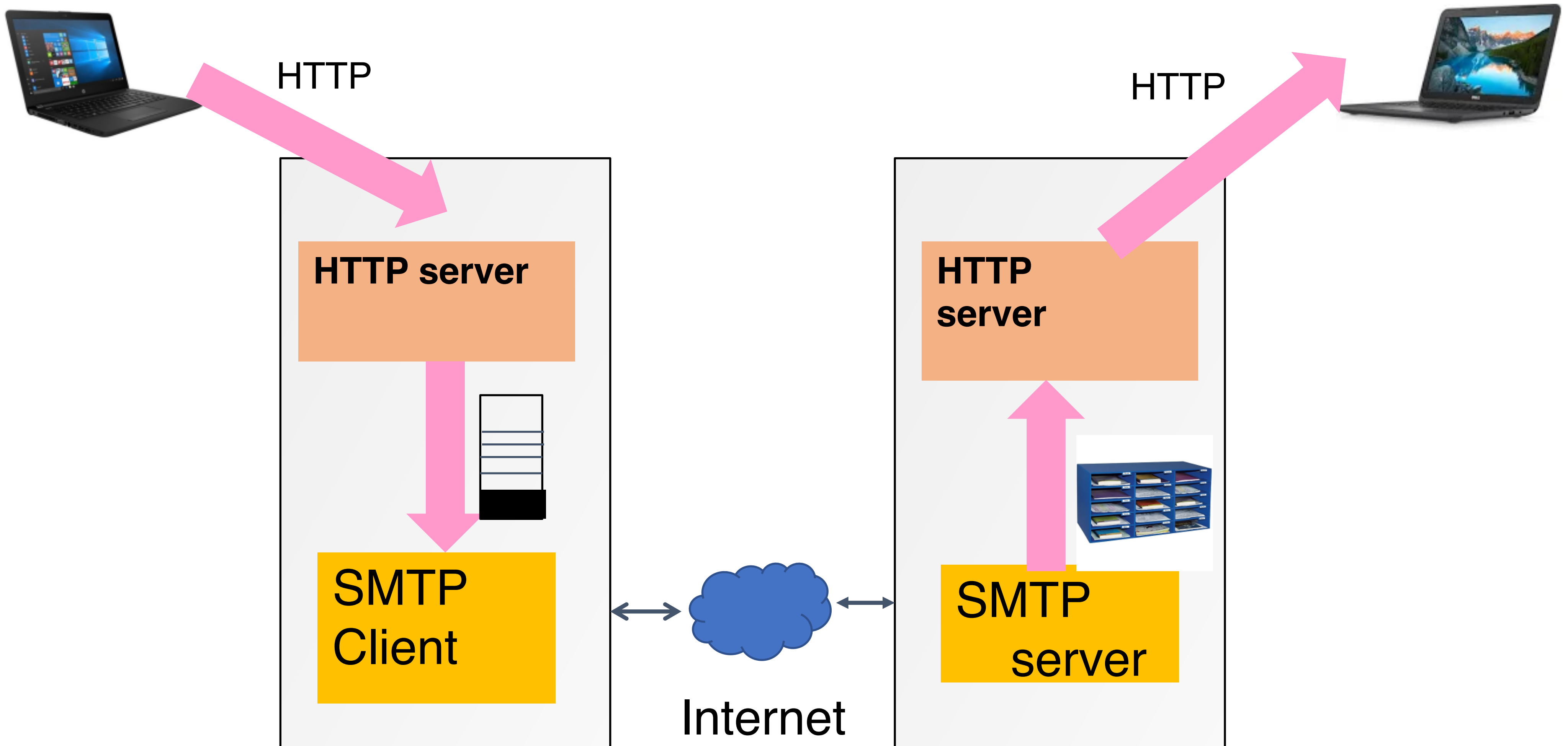
- IMAP4
- Stateful server
- UA and server processing
- Server sees folders, etc. which are visible to UAs
- Changes visible at the server
- Complex protocol

What about web-based email?

- Connect to mail servers via web browser
  - Ex: gmail, outlook, etc.

- Browsers speak HTTP
- Email servers speak SMTP
- Need a bridge to retrieve email using HTTP

Web based email



Comparing SMTP with HTTP

- HTTP: pull
- SMTP: push

- both have ASCII command/response interaction, status codes

- HTTP: each object encapsulated in its own response msg
- SMTP: multiple objects sent in multipart msg

- HTTP: can put non-ASCII data directly in response
- SMTP: need ASCII-based encoding

More themes from app-layer protocols

- Separation of concerns. Examples:
  - Content rendering for users (browser, UA) separate from protocol operations (mail server)
  - Reliable mail sending and receiving: mail UA doesn't need to be "always on" to send or receive email reliably
- In-band vs. out-of-band control:
  - In-band: headers determine the actions of all the parties of the protocol
  - There are protocols with out-of-band control, e.g., FTP
- Keep it simple until you really need complexity
  - ASCII-based design; stateless servers. Then introduce:
  - Cookies for HTTP state
  - IMAP for email organization
  - Security extensions (e.g., TLS)
  - Different methods to set up and use underlying connections (e.g., persistence)