

Application Layer: FTP & Email

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Class Location: ICT 121

Lectures: MWF 12:00 - 12:50

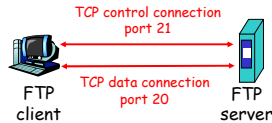
Notes derived from "Computer Networking: A Top Down Approach Featuring the Internet", 2005, 3rd edition, Jim Kurose, Keith Ross, Addison-Wesley.

Slides are adapted from the companion web site of the book, as modified by Anirban Mahanti (and Carey Williamson).

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File Transfer Protocol (FTP)

- FTP client contacts FTP server at port 21, specifying TCP as transport protocol
- Client obtains authorization over control connection
- Client browses remote directory by sending commands over control connection.
- When server receives a command for a file transfer, the server opens a TCP data connection to client
- After transferring one file, server closes connection.



- Server opens a second TCP data connection to transfer another file.
- Control connection: "out of band"
- FTP server maintains "state": current directory, earlier authentication

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FTP commands, responses

Sample commands:

- sent as ASCII text over control channel
- USER *username*
- PASS *password*
- LIST return list of file in current directory
- RETR *filename* retrieves (*gets*) file
- STOR *filename* stores (*puts*) file onto remote host

Sample return codes

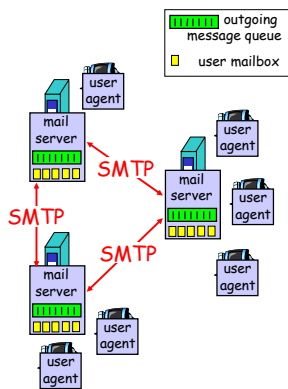
- status code and phrase (as in HTTP)
- 331 Username OK, password required
- 125 data connection already open; transfer starting
- 425 Can't open data connection
- 452 Error writing file

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Electronic Mail

Three major components:

- user agents
 - e.g., Eudora, Outlook, Pine, Netscape Messenger
- mail servers
 - Incoming, outgoing messages
- Simple Mail Transfer Protocol: SMTP



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Electronic Mail: SMTP [RFC 2821]

- Client's SMTP mail server establishes a TCP connection to the recipients SMTP server using Port 25
- three phases in msg. transfer
 - handshaking (greeting)
 - transfer of messages
 - closure
- command/response interaction
 - commands: ASCII text
 - response: status code and phrase
- messages must be in 7-bit ASCII

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Sample SMTP interaction

```
S: 220 hamburger.edu
C: HELO crepes.fr
S: 250 Hello crepes.fr, pleased to meet you
C: MAIL FROM: <alice@crepes.fr>
S: 250 alice@crepes.fr... Sender ok
C: RCPT TO: <bob@hamburger.edu>
S: 250 bob@hamburger.edu ... Recipient ok
C: DATA
S: 354 Enter mail, end with "." on a line by itself
C: Do you like ketchup?
C: How about pickles?
C: .
S: 250 Message accepted for delivery
C: QUIT
S: 221 hamburger.edu closing connection
```

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Try SMTP interaction for yourself:

- ❑ telnet servername 25
 - ❑ see 220 reply from server
 - ❑ enter HELO, MAIL FROM, RCPT TO, DATA, QUIT commands
- above lets you send email without using email client (reader)

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SMTP: final words

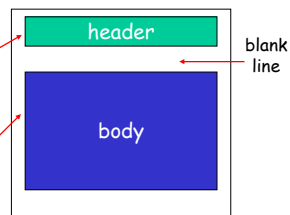
- ❑ SMTP uses persistent connections
 - ❑ SMTP requires message (header & body) to be in 7-bit ASCII
 - ❑ SMTP server uses CRLF . CRLF to determine end of message
 - ❑ SMTP is a "chatty" protocol
- Comparison with HTTP:**
- ❑ HTTP: pull
 - ❑ SMTP: push
 - ❑ both have ASCII command/response interaction, status codes
 - ❑ HTTP: each object encapsulated in its own response msg
 - ❑ SMTP: multiple objects sent in multipart msg

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Mail message format

SMTP: protocol for exchanging email msgs
RFC 822: standard for text message format:

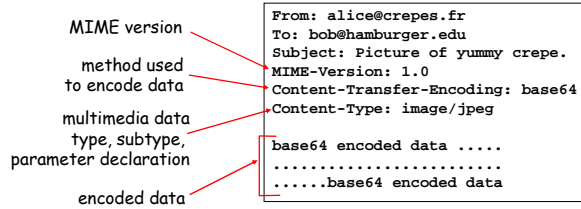
- ❑ header lines, e.g.,
 - To:
 - From:
 - Subject:*different from SMTP commands!*
- ❑ body
 - the "message", ASCII characters only



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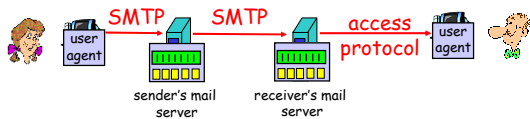
Message format: multimedia extensions

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



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Mail access protocols



- SMTP is a push protocol. How will a user access emails?
- Mail access protocol: retrieval from server
 - POP: Post Office Protocol [RFC 1939]
 - Users can't create folders on mail server
 - IMAP: Internet Mail Access Protocol [RFC 1730]
 - more features (more complex)
 - manipulation of stored msgs on server
 - HTTP: Hotmail, Yahoo! Mail, etc.

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