Application Protocols

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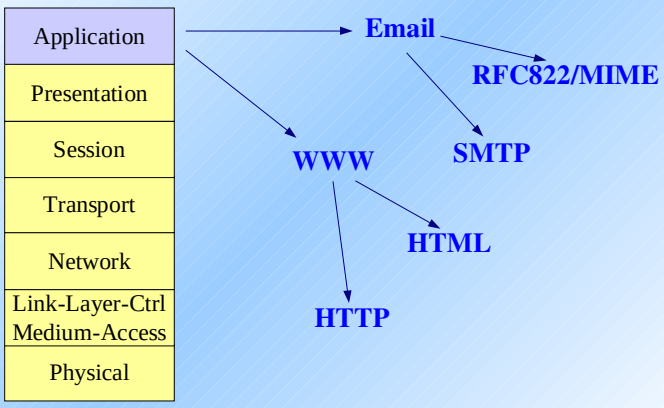
The Application Layer in the OSI Networking Stack



RFC822

- Message: header + body
  - Both assumed to be ASCII
- Header has a set of "type: value<CRLF>"
- Examples:
  - From: abc@iitk.ac.in
  - To: xyz@yahoo.com
  - Subject: an example subject line
  - Date: Wed, 4 May 2005 22:18:41 +0530 (IST)
- Body separated from header by an empty line

Multipurpose Internet Mail Extensions (MIME)

- Need to send different types of data: audio, images, postscript, etc.
- MIME defines three things:
  - More header lines
  - Set of content types and subtypes
  - Various "encodings" of the data types

MIME Headers

- Mime-Version:
- Content-Description:
- Content-Type:
- Content-Transfer-Encoding:
- Etc.

MIME types and subtypes

- Examples:
  - image/gif, image/jpeg
  - text/plain
  - text/richtext
  - application/postscript
  - application/msword

MIME Encodings

- base64, 7bit
- base64 is used for encoding binary data, such as jpeg images
- 3 bytes broken up into four 6-bit units
  - Encoded using a-z, A-Z, 0-9, +, /

The Email Application

- Distinguish between:
  - Mail reader: e.g. pine, mozilla-mail, outlook, thunderbird
  - Mail storage
  - Mail daemon: a process running on a computer which sends/receives email messages
  - Mail gateways: a machine which stores and forwards email messages
    - Much like an IP gateway

SMTP: Simple Mail Transfer Protocol

- SMTP is used between any two daemons
- Request response protocol, based on ASCII messages
  - Each request has a return code, and a human readable message
- Many of the requests are very much like RFC822 header lines

The World Wide Web (WWW)

- Almost synonymous with the Internet
- Distinguish between
  - Client (web browser)
  - Server
  - Proxy
  - URL

Hyper-Text Transfer Protocol (HTTP)

- Text-oriented protocol
- General format:
  - START_LINE <CRLF>
  - MESSAGE_HEADER <CRLF>
  - <CRLF>
  - MESSAGE_BODY <CRLF>

HTTP Request

- Specifies three things:
  - The operation to perform
  - The web page to perform the operation on
  - The version of HTTP used
- Two most common operations: GET and HEAD
- Important header field: If-Modified-Since

HTTP Response

- First line gives:
  - HTTP version, status code, text string explanation
- Status code:
  - 1xx: informational
  - 2xx: success
  - 3xx: redirection
  - 4xx: client error
  - 5xx: server error

TCP Connections

- HTTP 1.0 established one TCP connection per object
- HTTP 1.1 uses persistent connections
  - Load on server is reduced
  - TCP slow-start phase is avoided
- But, persistent connections ==> server load may be large in the long run

Caching

- Benefits:
  - Client, server, the network
- Where to cache?
  - Browser, proxy
- Use “Expires” header field to expire data

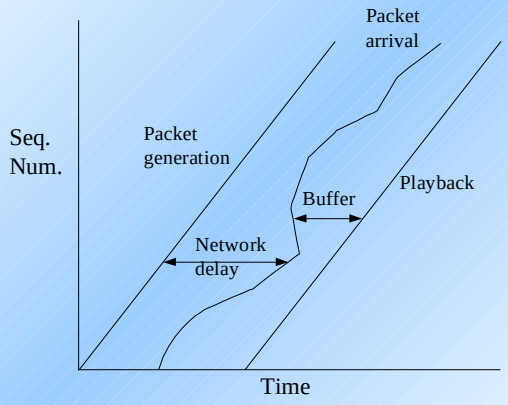
Streaming Applications

- RTP (Real-Time Protocol)
  - Defines sequence number, timestamp, etc.
- SIP (Session Initiation Protocol)
  - Defines the signaling required for establishing a voice/video call
- H.323 is a competitor for SIP

Quality of Service (QoS) in Streaming Applications

- Delay and jitter are important
  - Playback point: packets arriving after playback point are *useless*

Using a Playback Buffer



Taxonomy of Applications