The World Wide Web (WWW)

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Background

- Enormously popular application that provides a tremendous wealth of information
- Origins: 1989 Tim Berners-Lee (CERN) proposed mechanism to distribute high-energy physics data (reports, photos, blueprints etc)
  - Proposal eventually lead to World Wide Web (WWW)
- 1993, first graphical browser Mosaic was released
- 1994, W3C (world wide web consortium) was formed to develop web and standards

Jargon

- **Web page** consists of base **HTML** file which includes several referenced **objects**
  - Object can be other HTML files, JPEG images, Java applets, audio files,……
  - Text/Image that links to another page is called a **hyperlink** (often highlighted by some means)
- Each object is addressable by a **URL** (Uniform Resource Locator)
  - E.g. http://www.iitb.ac.in/images/header/iitb_logo.gif

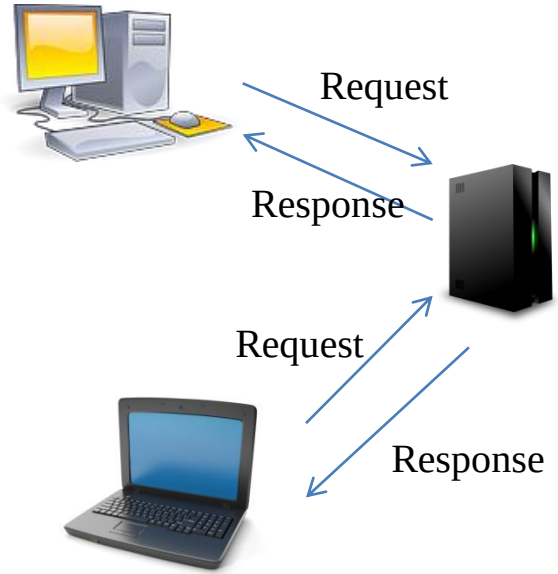
Protocol | Host Name | Path

Jargon

- Web pages are written in Hyper Text Markup Language (**HTML**)
  - Describes how document is to be displayed
  - Other assisting tools are CSS, XML, XSL
- Web pages are viewed by a program called a **browser**
  - E.g. Internet Explorer, Google Chrome, Mozilla Firefox

Hyper Text Transfer Protocol (HTTP)

- The protocol employed by Web application
- Based on client-server model
  - Client (browser) requests web objects
  - Server responds with status code and requested object (if present)

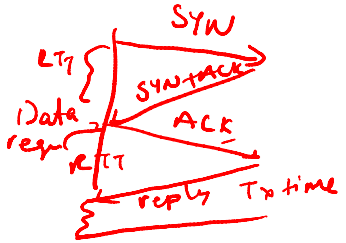


Hyper Text Transfer Protocol (HTTP)

- Operates over TCP, server port 80
- Two Versions:
  - HTTP 1.0 (RFC 1945)
  - HTTP 1.1: (RFC 2068)
- Stateless protocol: no user information stored across requests

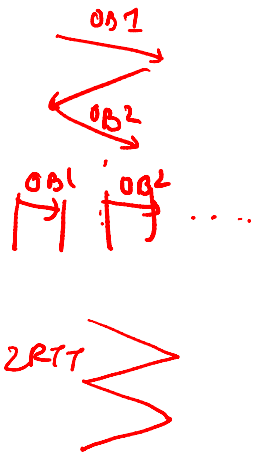
HTTP Non-persistent Connection

- Used by HTTP/1.0
- At most one object is sent over a TCP connection
- Rather inefficient in terms of operating system overhead (especially at server) and response time
  - Response Time: Time when a request was made and the object fully received
  - Takes 2RTT +TX-time per object



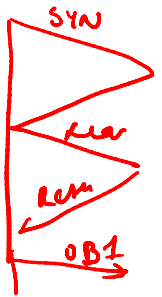
Example

- Download a html webpage with 5 embedded objects
- What is the overall response time to display the webpage fully?
  - Assume object fits within one packet
  - Assume objects requests are made sequentially
    - Total Time is 2RTT + 5*2RTT = 12 RTT
  - What if the object requests are made parallely?
    - Total time is ~ 2RTT + 2RTT = 4RTT



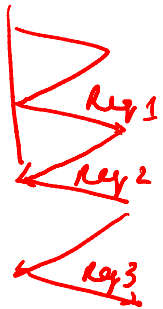
HTTP Persistent Connections

- Used by HTTP 1.1
- Server connection left open for subsequent requests
  - Helps reduce TCP related overhead (buffers, state etc) at server



HTTP Persistent Connections

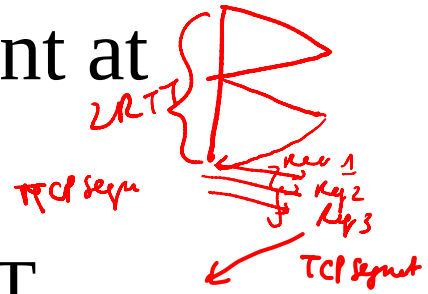
- Two modes of operation:
- Non-pipelined: new request sent only after previous request completes
  - Example: html page with 5 embed object
    - Total time: 2RTT+ 5RTT = 7RTT



- Pipelined: Multiple requests can be sent at once; default mode of operation

depends on TCP .. cwnd slow start etc

  - Minimum total time: 2RTT+RTT = 3RTT



Break