

COMS3200 Study Notes

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1 Internet?

- Collection of billions of connected devices.
- Connected via **communication links** such as fiber, copper, radio and satellites.
- Controlled by **packet switches** such as routers and switches.
- Standardized by **protocols** such as TCP, IP, HTTP, Skype, 802.11
- Standards are made by organizations such as **RFC: Request for comments** and **IETF: Internet Engineering Task Force**

Actually a network of networks (ISPs connected together)
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2 Protocol?

Protocols define a guide for messages (packets) sent and received between network entities by defining the:

- **format** of messages
- **order** of messages
- **actions** taken when messages are transmitted or received

3 Network Edge/Core

Network Edges are host devices i.e. client machines or servers.

Network Cores are interconnected routers.

Frequency division multiplexing: different channels transmitted in different frequency bands

4 Application Layer

The Application Layer provides the interface between the end-user and network communication.

Implementation aspects of network protocols

- transport-layer service models
- client-server paradigm

5 Network Applications

Network applications run on **different end systems** (network edges) and **communicate over the network**.

Network applications **do not** run on network cores.

Network applications allow for **rapid app development and propagation**.

6 Network Architectures

- Client-server
- Peer-to-peer (P2P)

Client-server Architecture is the classical architecture consisting of communication between **multiple clients** and a **singular server**.

The server is **always-on** with a **fixed address** that **can be scaled** to multiple devices. Clients communicate with directly with the server and **do not need to be always on or have a fixed address**. Clients **do not communicate with each other**.

Peer-to-peer Architecture is a form of network communication where clients (now peers) do not connect to an always-on server and instead **communicate directly with each other**.

Peers request service from other peer and provide service in return to other peers. Think torrents.

Peers are **intermittently connected and can change addresses**.

7 Processes

A **Process** is a program running within a host.

Inter-process communication is two processes communicating on the same host.

Messages are exchanged by processes communicating on different hosts.

Client process: initiates communication

Server process: waits for communication from clients

P2P Applications have both client and server processes

8 Sockets

Processes send and receive messages to and from sockets.

Sockets are connections between host devices.

9 Addressing Processes

Processes require **identifiers** so that messages can be sent back to the correct process.

Each **host** has a **32-bit IP address**.

A host can have **multiple processes** so IP addresses are combined with **port numbers** as **identifiers**.

10 App-Layer Protocol

App-Layer Protocol defines:

- **type of message** e.g. request, response

- **message syntax:** message fields and encoding
- **message semantics:** meaning of the fields
- **rules:** how processes should send/receive messages

Open protocols:

- defined in **RFCs**
- allows for **interoperability**

Proprietary protocols:

- normally implemented for a specific proprietary application

11 Transport Service Considerations

Data Integrity Reliability of data to reach the destination. Some applications require all data to reach the destination.

Timing Speed transportation takes. Some applications require fast transportation to work well.

Throughput Amount of data in a transfer. Some applications require large throughput while others require minimal throughput.

12 TCP & UDP

TCP

- **reliable** transport protocol
- **flow control** prevent overwhelming receiver
- **congestion control** prevent overwhelming network
- **no** timing, minimum throughput guarantee, security
- **setup required** connections need to be established

UDP

- **unreliable** transport protocol
- **no** flow control, congestion control, timing, throughput guarantee, security, or connection setup

13 Secure TCP

TCP & UDP connections have **no encryption**.

SSL connections are encrypted TCP connections.

SSL connections increase **data integrity** and offer **end-point authentication**.

SSL is an application layer protocol. Applications use SSL libraries.

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15 HTTP: Hypertext Transfer Protocol

Application protocol for websites.

Client requests web objects from server.

Server responds with web objects when requested.

HTTP uses TCP connections (port 80)

HTTP is a **stateless protocol**. Server does not maintain client information.

Persistent HTTP allows **multiple objects** per connection.

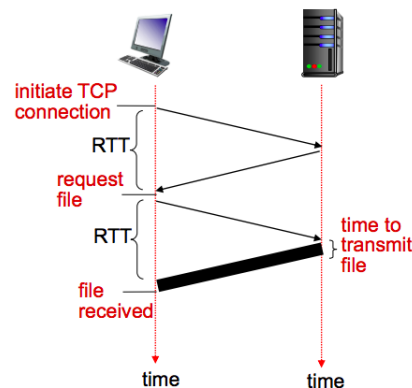
16 Non-persistent HTTP

Non-persistent HTTP restricts **one object** per connection.

1. Client makes TCP connection to port 80 using a socket
2. Server accepts incoming TCP connection
3. Client sends request message over socket to access a resource
4. Server responds with requested resource
5. Server closes connection
6. Client receives requested resource

17 Non-persistent HTTP Time

RTT: time for a packet to travel from a client to a server and back.



Non-persistent Response Time = initial RTT + request RTT + file transmission time

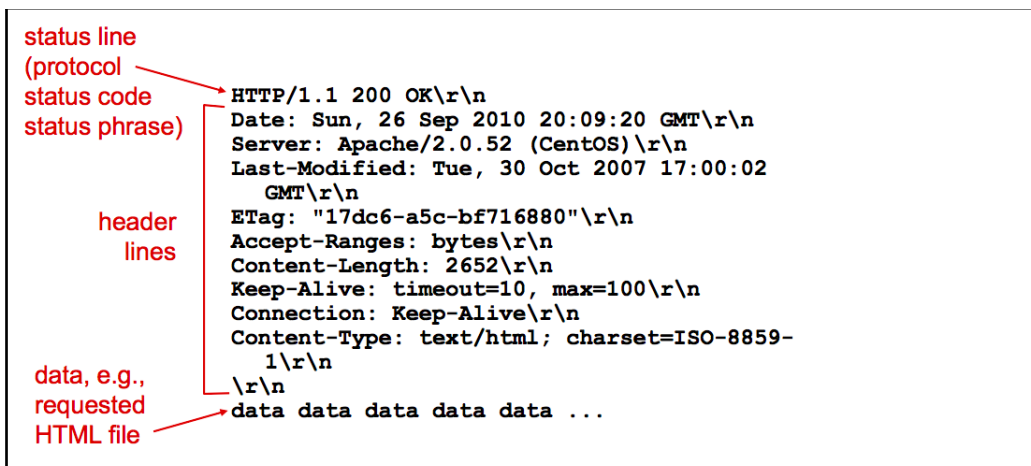
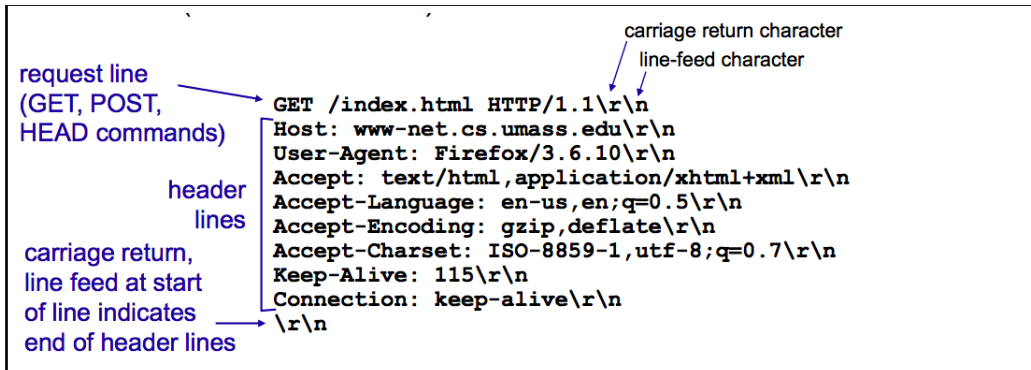
18 Persistent HTTP

Non-persistent HTTP requires 2 RTTs + OS overhead for each object.

Persistent HTTP leaves connections open allowing for as little as 1 RTT per object.

19 HTTP Messages

There are **request** and **response** HTTP messages



Method Types

HTTP 1.0 Methods: GET, POST, HEAD	HTTP 1.1 Methods: GET, POST, HEAD, PUT, DELETE
HEAD asks the server to not send back the requested object.	PUT uploads object to the given URL
	DELETE deletes object at given URL

Response Codes

- 200 OK
- 301 Moved Permanently
- 400 Bad Request
- 404 Not Found
- 505 HTTP Version Not Supported