The internet, the web, and the relationship between them:

* Internet is made up of protocols, standards, services, and hardware
* The web is an application running on the internet

Five layers of the internet stack

* Application Layer
* Transport layer
* Network layer
* Link layer
* Physical layer

Web caching can reduce delay on receiving a requested object because:

* Web cache sits closer to end user from the hosting service
* Only works for object already in cache

UDP server client needs only one socket, but TDP server needs two sockets:

* TCP has a listening socket to accept new connections, and a socket for ongoing communication
* UDP does not make this distinction, connectionless

TCP uses various techniques to address both corrupted packets and lost packets

* Corrupted packets:
  + Checksums: Used to determine if packet corrupted in flight
  + ACK
  + Sequence numbers:
* Lost packets:
  + ACK messages
  + SQN messages
  + Timers

Pipeline

* In TCP, sending multiple packets back to back without waiting for an ack, to solve the issue with low link utilization

How ACK messages will be generated with the following circumstances:

* Arrival of in-order segment with expected seqn
  + Wait for 500 ms, send ACK
* Arrival of in-order segment with expected seq, one segment has ACK pending
  + Immediately send ACK for receives seq
* Out-of-order segment with higher than expected seq
  + Immediately send ACK for last in-order packet
* Arrival of segment that completely fills in gap
  + Imeedietely send packet out highest in-order seq #

Congestion control:

* Attempts to avoid problems at network level, where router queues overflow

Flow control:

* Attempts to avoid problems at receiver when ender sends faster than receiver reads

False:

* Consider congestion control in TCP. When the timer expires at the sender, the value of ssthresh if set to one half of its previous value.
* The size of the TCP rcwd never changes throughout the duration of the connection
* Suppose Host A is sending a large file to Host B over a TCP connection. If the sequence number for a segment of this connection is m, then the sequence number for the next segment will necessarily be m+1.

True:

* Multiplexing is a service that all transport services must provide.
* Suppose Host A is sending a large file to Host B over a TCP connection. The number of unacknowledged bytes that A sends cannot exceed the size of the receive buffer\

Multiplexing:

* Takes data from many apps, sends it to single pipe, breaks up at the other end using ports
* TCP relies on a 4-typle, UDP relies on a 2-tuple

Compute UDP checksum:

* Source port + destination port + length + data + 1 (if overflow) => one’s complement

Connection establishment

* SYN = (establishing handshake)
* Seq = Seq + Data + 1
* Ack = Seq + Data

queuing delay at input line:

* Caused by switching fabric being too slow
* Needs to be less than (lines \* line rate) to mostly eliminate queuing

Can’t eliminate queuing delay at output ports because:

* Can’t make output line speed faster than switching fabric speed

DHCP

* Gives new clients their IP, renews IP address

Routing

* Switching table tells which link connects to which MAX address
* Two ways to update table:
  + Whenever packet goes through it updates with MAC of packet
  + When packet arrives without unknown MAC, broadcasts flood packet that goes to all links

Security:

* Purpose: Confidentiality, integrity, authentication
* Message authentication codes <- secret keys
* Digital signatures <- public key cryptography
* Real time authentication <- nonces
* Certificate authority
  + Lets people trust public key belongs to who it claims to
  + Trust because of institutional capital and social reasons