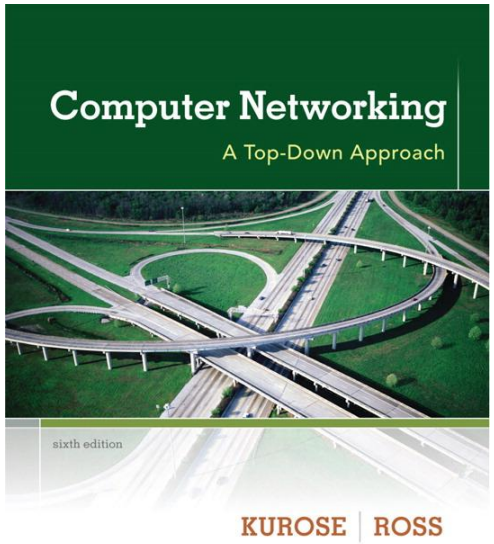
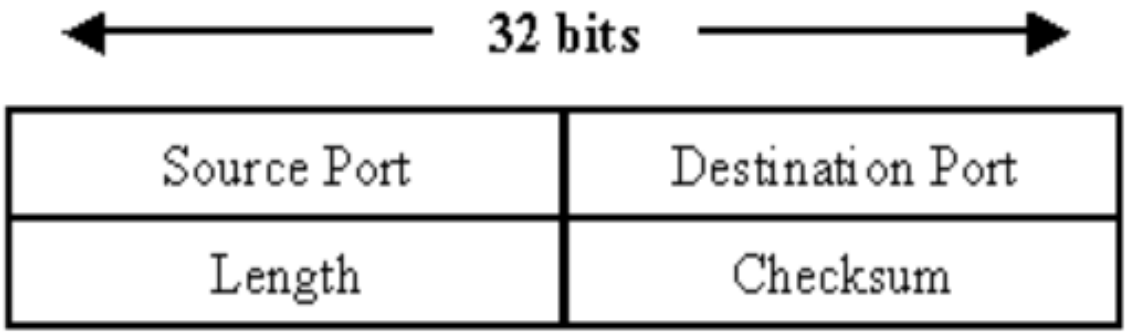
CST4500 – Additional Notes for Lab 4b



Computer Networking: A Top Down Approach

Jim Kurose, Keith Ross

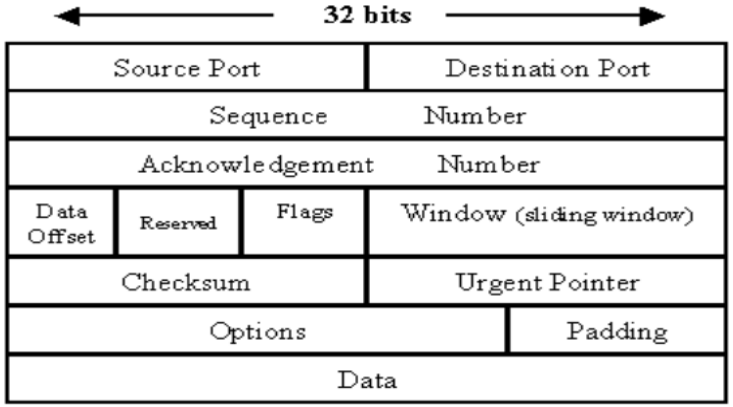
UDP Frame Format



- The UDP packet format contains four fields:

- **Source Port** and **Destination Port fields** (16 bits each) identify the end points of the connection.
- **Length field** (16 bits) specifies the length of the header and data.
- **Checksum field** (16 bits) allows packet integrity checking (optional).

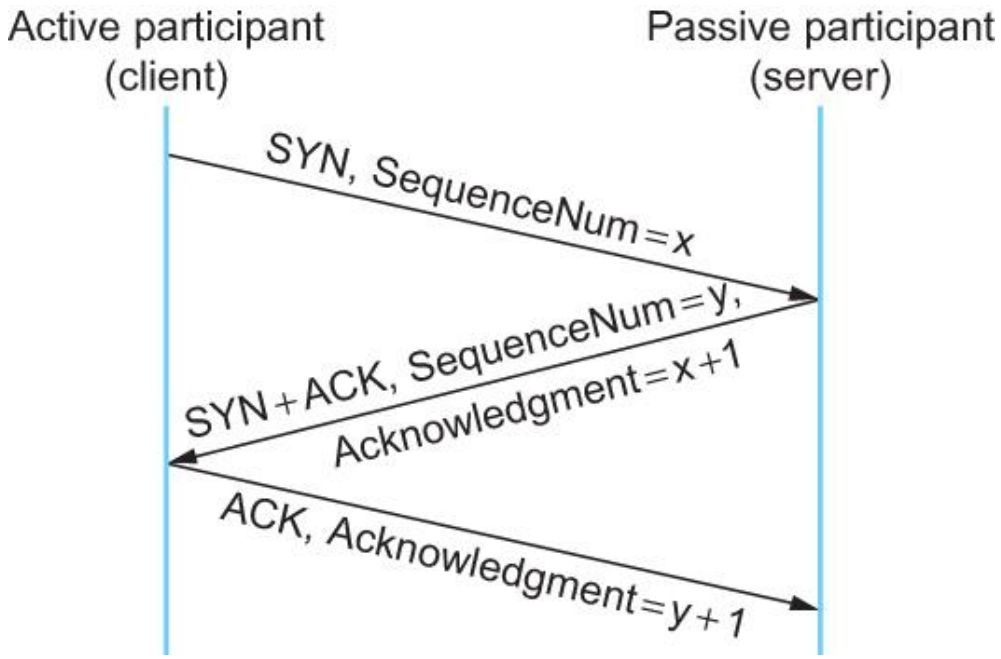
TCP Frame Format



- The TCP packet format consists of these fields:

- **Source Port** and **Destination Port fields** (16 bits each) identify the end points of the connection.
- **Sequence Number field** (32 bits) specifies the number assigned to the first byte of data in the current message. Under certain circumstances, it can also be used to identify an initial sequence number to be used in the upcoming transmission.
- **Acknowledgement Number field** (32 bits) contains the value of the next sequence number that the sender of the segment is expecting to receive, if the ACK control bit is set. Note that the sequence number refers to the stream flowing in the same direction as the segment, while the acknowledgement number refers to the stream flowing in the opposite direction from the segment.
- **Data Offset (a.k.a. Header Length) field** (variable length) tells how many 32-bit words are contained in the TCP header. This information is needed because the Options field has variable length, so the header length is variable too.
- **Reserved field** (6 bits) must be zero. This is for future use.
- **Flags field** (6 bits) contains the various flags:
  URG—Indicates that some urgent data has been placed.
  ACK—Indicates that acknowledgement number is valid.
  PSH—Indicates that data should be passed to the application as soon as possible.
  RST—Resets the connection.
  SYN—Synchronizes sequence numbers to initiate a connection.
  FIN—Means that the sender of the flag has finished sending data.
- **Window field** (16 bits) specifies the size of the sender's receive window (that is, buffer space available for incoming data).
- **Checksum field** (16 bits) indicates whether the header was damaged in transit.
- **Urgent pointer field** (16 bits) points to the first urgent data byte in the packet.
- **Options field** (variable length) specifies various TCP options.
- **Data field** (variable length) contains upper-layer information.

Connection Establishment/Termination in TCP



Timeline for three-way handshake algorithm

TCP round trip time, timeout

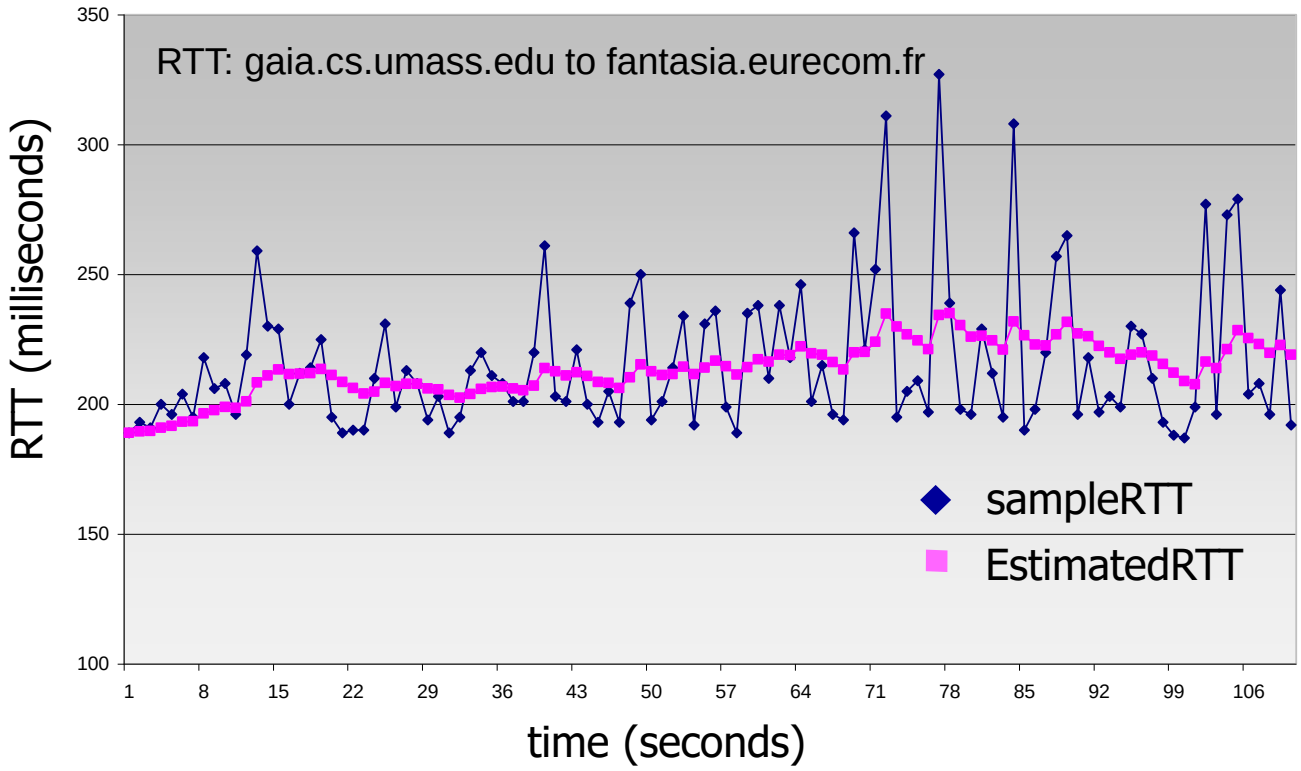
Q: How to estimate RTT?

- **`SampleRTT`**: measured time from segment transmission until ACK receipt
  - ignore retransmissions
- **`SampleRTT`** will vary, want estimated RTT "smoother"
  - average several *recent* measurements, not just current **`SampleRTT`**

TCP round trip time, timeout

EstimatedRTT = (1- α)*EstimatedRTT + α*SampleRTT

- exponential weighted moving average
- influence of past sample decreases exponentially fast
- typical value: α = 0.125



Other points

- The difference between the acknowledged sequence numbers of two consecutive ACKs indicates the data received by the server between these two ACKs.
- The average throughput for the TCP connection is computed as the ratio between the total amount data and the total transmission time.
- The total amount data transmitted can be computed by the difference between the sequence number of the first TCP segment and the acknowledged sequence number of the last ACK.