TCP
Transmission Control Protocol

You are still here
TCP

- TCP is a full-duplex, connection-oriented, reliable protocol. TCP grabs data from a send buffer (containing data from applications), add TCP header, and pass to network layer for transmission. TCP can grab MSS bytes (maximum segment size) at one time.

- TCP header is 20 bytes (maybe longer if includes option header). Each segment contains a 32-bit sequence number and acknowledgement number. Sequence number is the byte number of the first byte in the segment; Acknowledgement number is the byte number of the first byte expected.

Data to Send

Data Received

<table>
<thead>
<tr>
<th>GBN</th>
<th>SR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACK</td>
<td>Cumulative</td>
</tr>
<tr>
<td>Out-of-Order</td>
<td>Throw</td>
</tr>
<tr>
<td>Retransmit</td>
<td>All unACK</td>
</tr>
<tr>
<td>Timer</td>
<td>One</td>
</tr>
</tbody>
</table>
Reliability in TCP

- TCP uses a mix of techniques from GBN and SR.
- Cumulative ACK: since ACK number tells sender which byte the receiver is expecting.
- Only one timer: for oldest unacknowledged segment.
- Receiver buffers out-of-order segments.
- Retransmit only one packet when timeout occurs.
- TCP retransmits if it receives duplicate ACKs, but only after 3 of them is received (fast retransmit)
Flow Control in TCP

- To avoid buffer overflow at receiver, the receiver limits the number of bytes the sender can send through a receiver window (rcvwin), which is the size of the spare room in the receiver buffer.
- The sender ensures that the amount of outstanding bytes (sent but not acknowledged) is less than rcvwin.
TCP Connection Management

- Other fields of interest in TCP header are bits to indicate type of packets (SYN, FIN, ACK, RST etc).
- To establish connection, TCP uses a 3-way handshake:
  A sends SYN to B, B replies with SYN+ACK, A replies with ACK+data (optional).
- To tear down connection, A sends FIN to B, B sends ACK back. B sends FIN to A, A sends ACK back to B.