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HW3 CSCI 466

1. On top of reliable data transfer, TCP also provides congestion control and ensures data arrives in order to the destination. Thus, if all links were reliable, TCP would still find use.

2. I would choose TCP as if I wanted to preserve the high quality of the image, TCP would ensure that all the data in the image arrives as it should without loss. Also, for a large file such as a high-quality image, TCP provides flow control which would ensure the recipient is not overwhelmed with data.

3. Sequence numbers allows a receiver to quickly determine if an incoming packet is a new packet or a retransmission of a previous packet due to a NAK or corrupted ACK.

   Timers tell the sender when to resend a packet if an ACK is likely to have been lost. Both are responsible for ensuring that the correct data arrives to the receiver.

4.
```
  01010011
 +01100110
----------
  10111001
 +01110111
----------
  00110001
```

   1s comp = 11001110

   UDP takes the 1s complement because later it is added to the sum of the 8-bit bytes to hopefully receive an output of all 1s. If 1s complement wasn't used, this error detection scheme wouldn't be correct. If any 0s are present in the sum of the bytes and the 1s complement then we know there were errors introduced.

```
  00110001
 +11001110
----------
  11111111      No errors!
```

   A 1-bit error would not go undetected as that would change the total checksum and register as an error.

5. **Slow Start** - A small window size is chosen and exponentially grows until a loss is detected at which it restarts the process but now stops just before the window size increase that resulted in loss in the previous attempt and transitions to Congestion Avoidance mode.

   Congestion Avoidance - Increases window size by one segment every RTT until a loss occurs where it is transitioned to Slow Start or Fast Recovery.

   Fast Recovery - Reduces window size to half of when duplicate ACK loss was detected adding MSSs for each duplicate ACK. After receiving the ACK for the missing segment, it then enters Congestion Avoidance again. If a timeout event occurs then Slow Start is invoked instead.