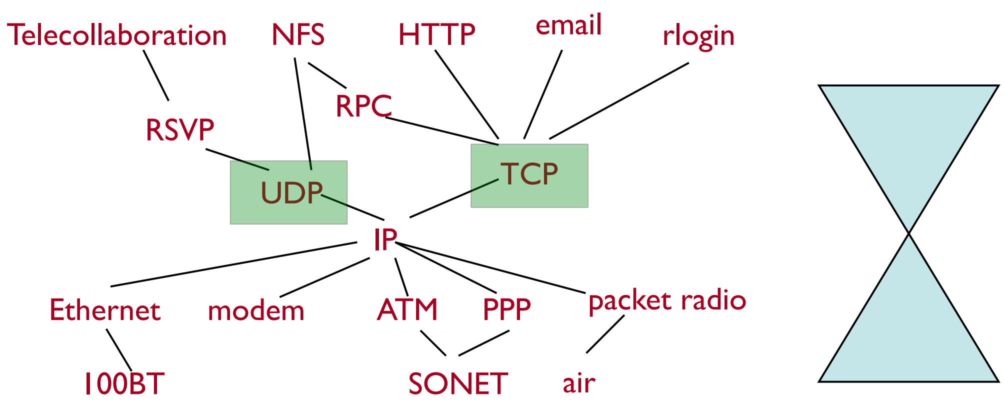
IP Hourglass (redux)



User Datagram Protocol (UDP)

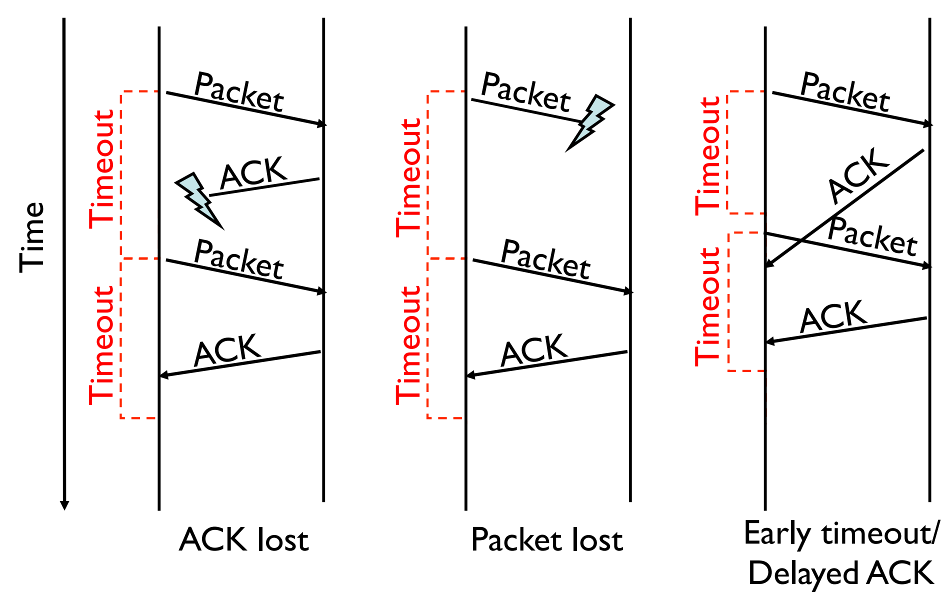
Link-layer	IP	SrcPort	DestPort	Checksum	Len	Data…

← UDP Header →

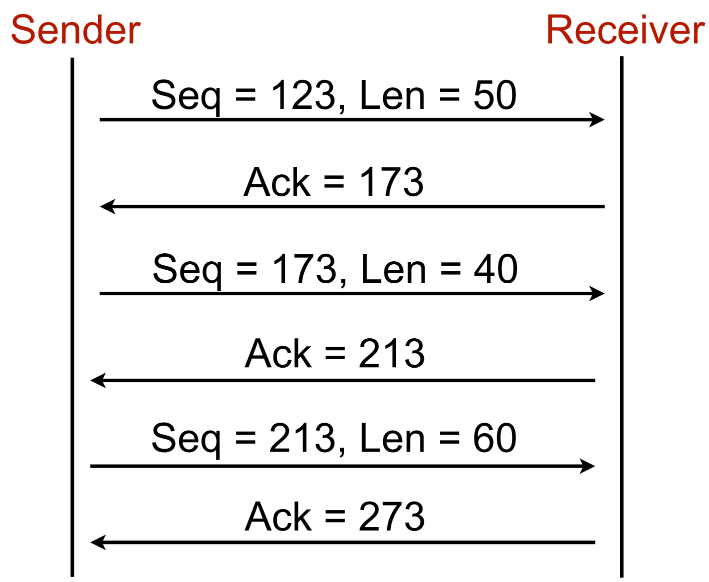
Transmission Control Protocol (TCP)

0	4	10	16	31
SrcPort			DestPort	
SequenceNum				
Acknowledgment				
HdrLen	000000	Flags	AdvertisedWindow	
CheckSum			UrgPtr	
Options (variable – max of 320 bits)				
Data				

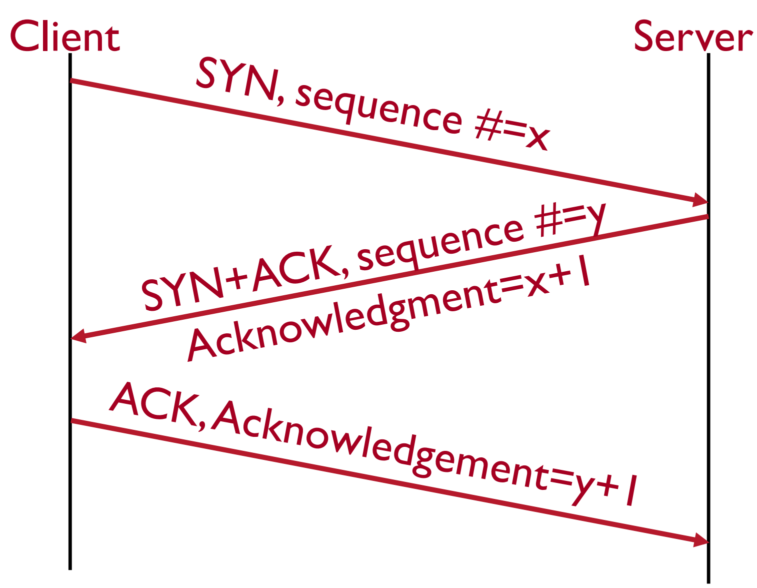
ACKs and Timeouts



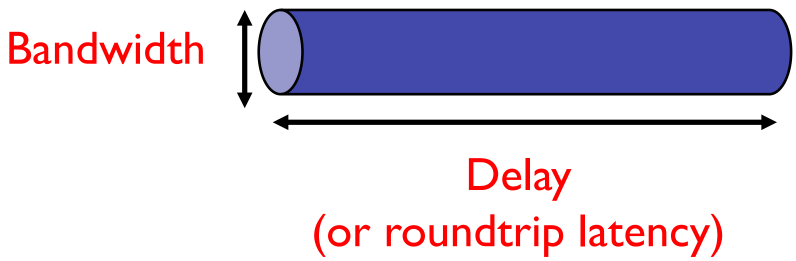
Sequence and ACK Numbers



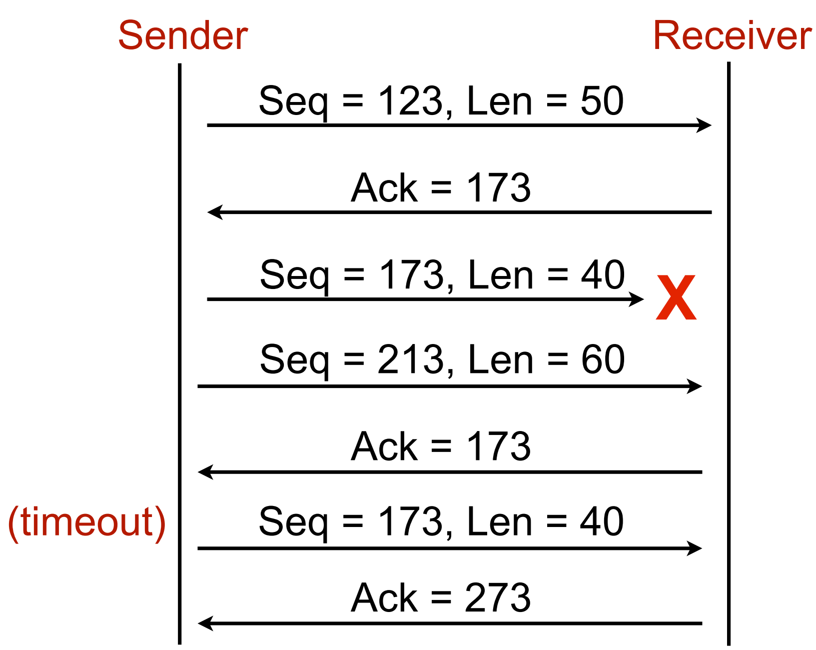
TCP Three-Way Handshake



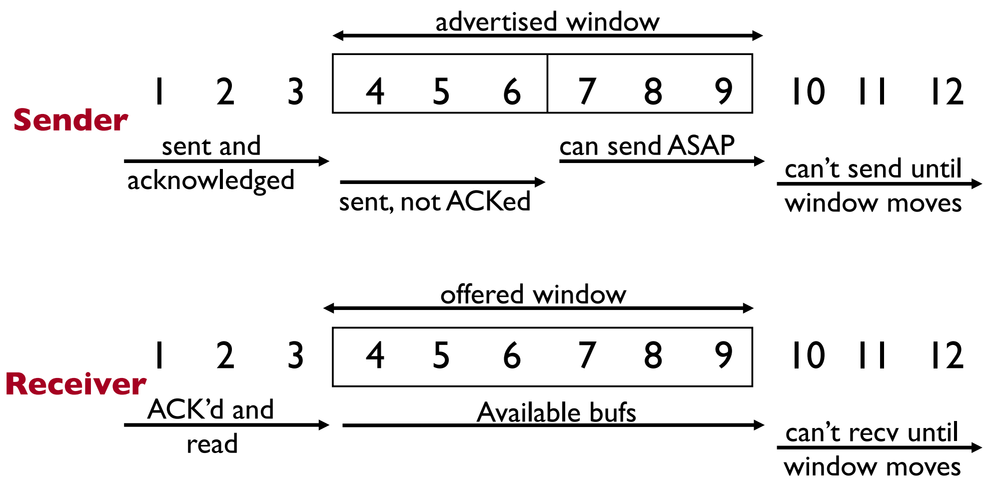
Filling the Pipe



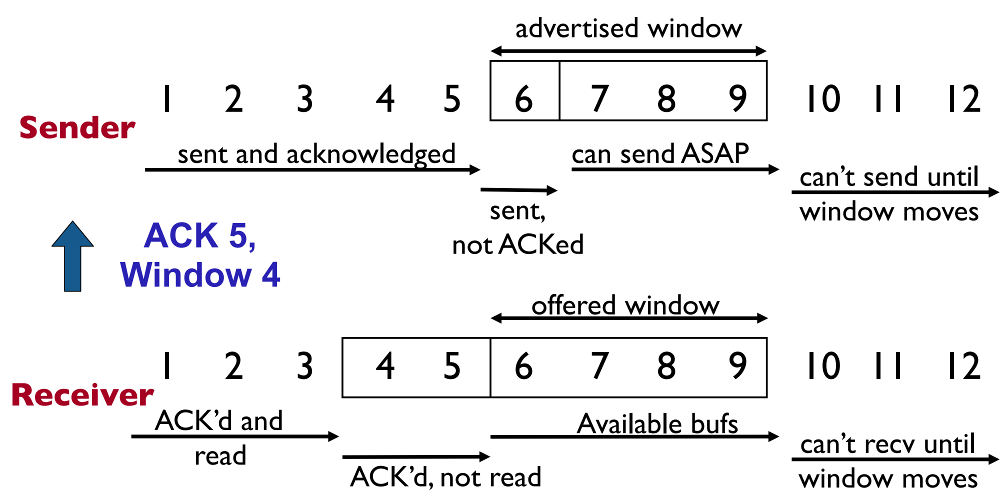
Lost Packets



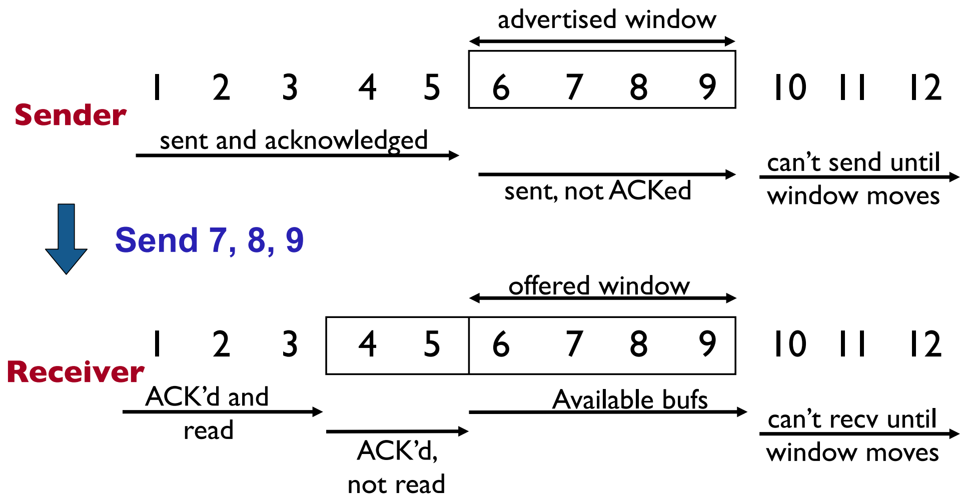
TCP Sliding Window (1)



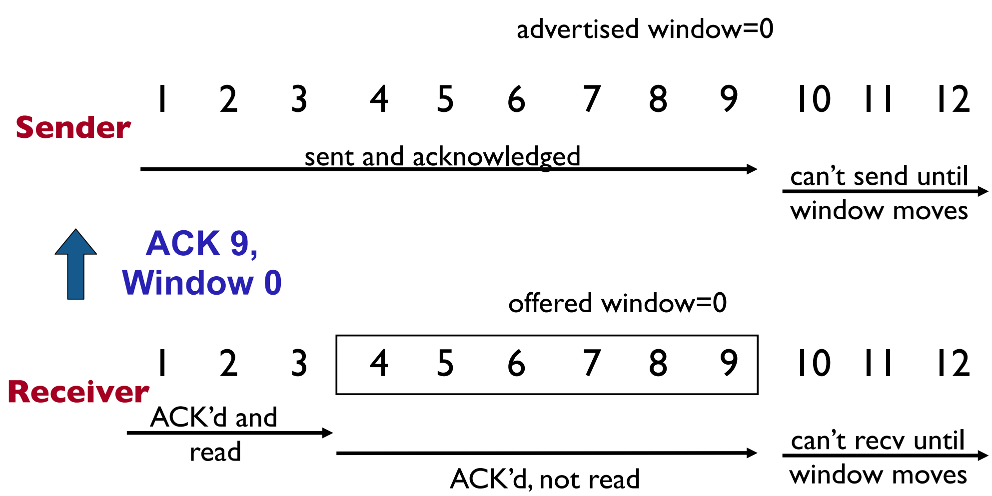
TCP Sliding Window (2)



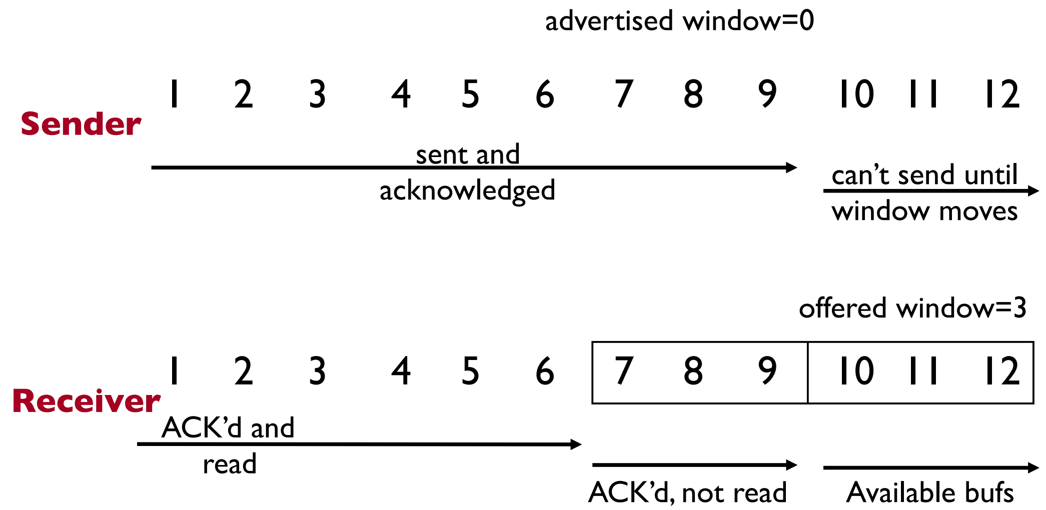
TCP Sliding Window (3)



TCP Sliding Window (4)

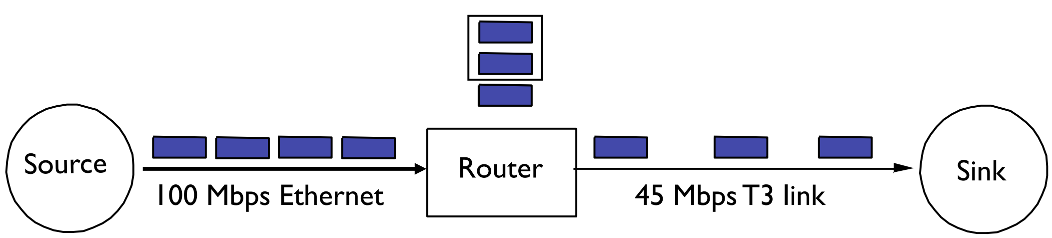


TCP Sliding Window (5)

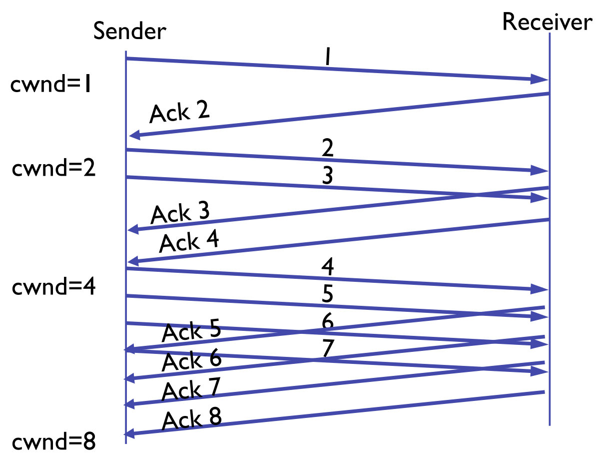


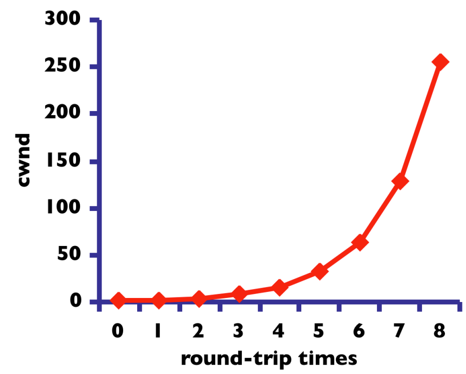
Read bytes 4, 5, 6

Congestion Control

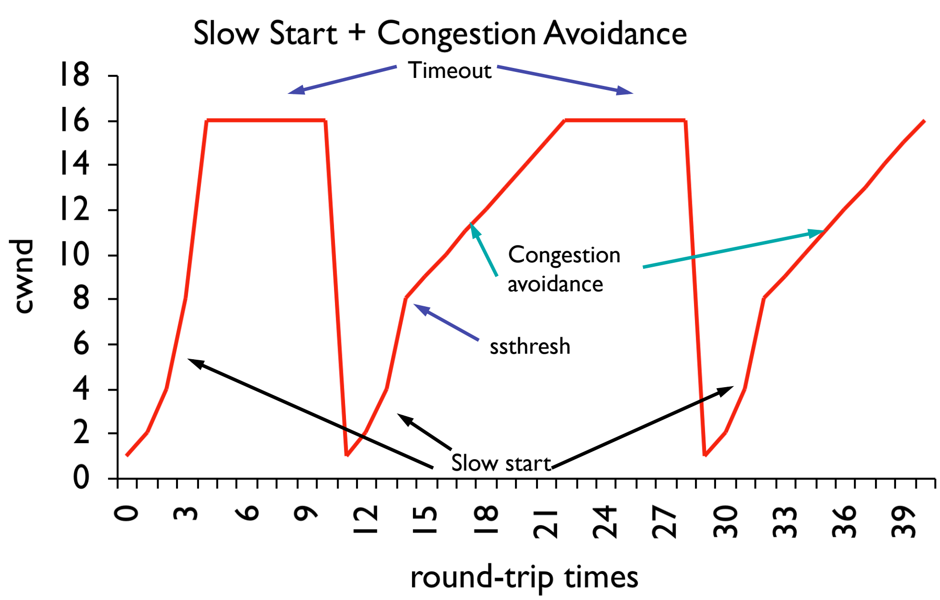


Slow Start

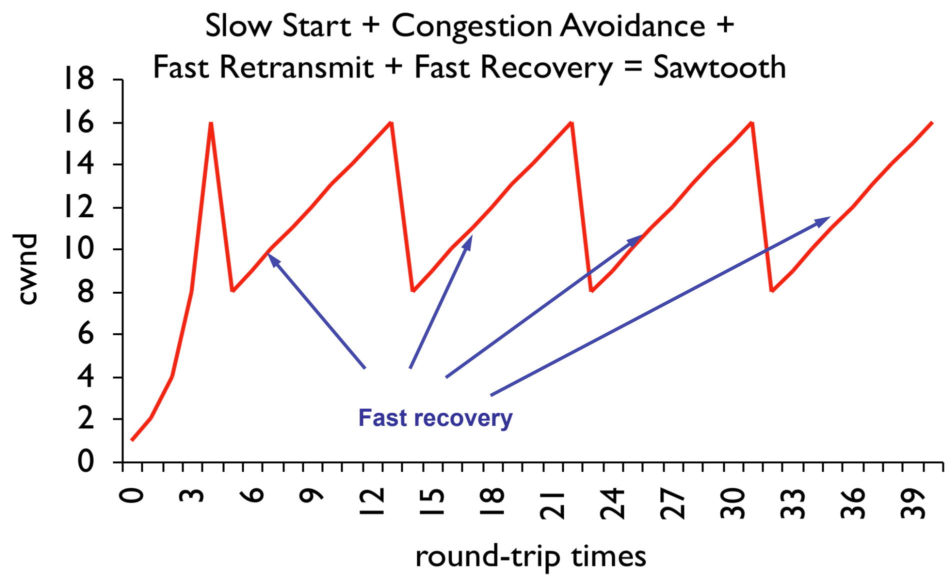




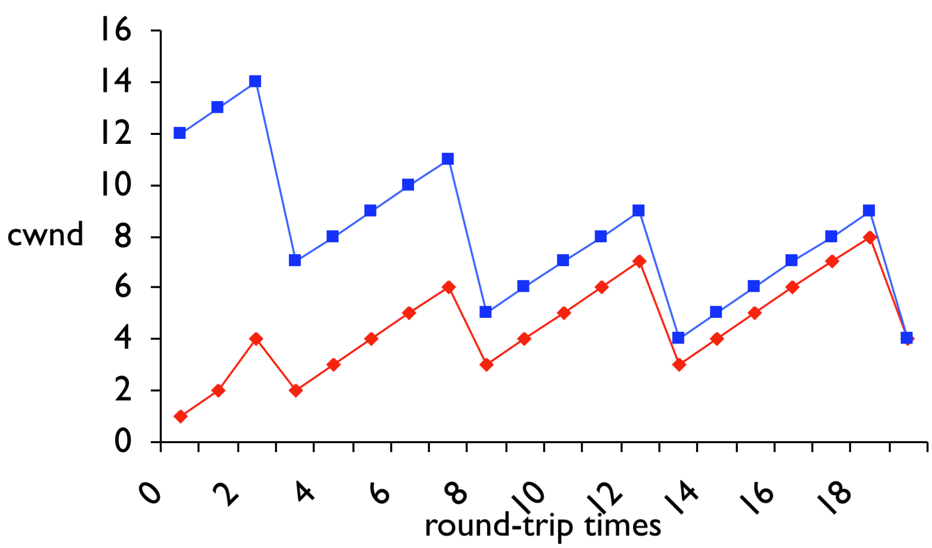
Slow Start + Congestion Avoidance



TCP Sawtooth Pattern



TCP Link Sharing



TCP/UDP Sharing