

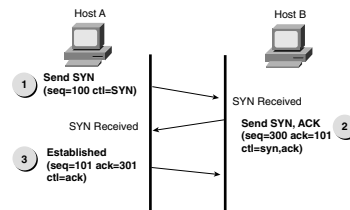
How TCP Connections Are Established

End stations use control bits called SYN (for synchronize) and Initial Sequence Numbers (ISN) to synchronize during connection establishment.

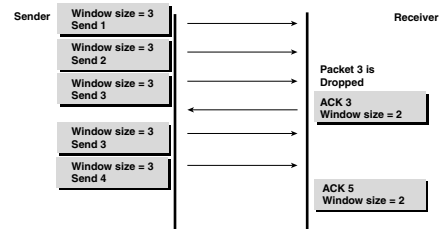
Three-Way Handshake

The synchronization requires each side to send its own initial sequence number and to receive a confirmation of it in acknowledgment (ACK) from the other side.

1. Host A sends a SYN segment with sequence number 100.
2. Host B sends an ACK and confirms the SYN it received. Host B also sends a SYN. The ACK field in host B now expects to hear sequence 101.
3. Host A sends an ACK verifying the SYN and passes data.



TCP Windowing



Windowing ensures that one side of a connection is not overwhelmed with data that it cannot process. The window size from one end station tells the other side of the connection how much it can accept at one time. With a window size of 1, each segment must be acknowledged before another segment is sent. This is the least-efficient use of bandwidth.

1. The sender sends three packets before expecting an ACK.
2. The receiver can handle only a window size of 2. So it drops packet 3, specifies 3 as the next packet, and specifies a window size of 2.
3. The sender sends the next two packets but still specifies its window size of 3.
4. The receiver replies by requesting packet 5 and specifying a window size of 2.

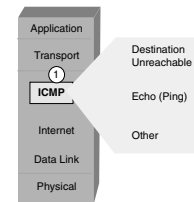
TCP Sequence and Acknowledgment Numbers

TCP uses forward reference acknowledgments. Each datagram is numbered so that at the receiving end TCP reassembles the segments into a complete message. If a segment is not acknowledged within a given time period, it is resent.

IP

IP provides connectionless, best-effort delivery routing of datagrams. The protocol field in the header determines the Layer 4 protocol being used (usually TCP or UDP).

Other Internet Layer Protocols



ICMP, ARP, and RARP are three protocols used by the Internet layer to IP. The *Internet Control Message Protocol* (ICMP) is used to send error and control messages. Messages such as destination unreachable, time exceeded, subnet mask request, echo, and others are used by ICMP.

Address Resolution Protocol (ARP) maps a known IP address to a MAC sublayer address. An ARP cache table is checked when looking for a destination address. If the address is not in the table, ARP sends a broadcast looking for the destination station.

Reverse ARP

Reverse Address Resolution Protocol (RARP) maps a known MAC address to an IP address. Dynamic Host Configuration Protocol (DHCP) is a modern implementation of RARP.

TCP/IP Overview Summary

- The TCP/IP protocol suite includes Layer 3 and 4 specifications.
- UDP is connectionless (no acknowledgments). No software checking for segment delivery is done at this layer.
- TCP is a reliable connection-oriented protocol. Data is divided into segments, which are reassembled at the destination. Missing segments are resent.
- Both TCP and UDP use port (or socket) numbers to pass information to the upper layers. A socket is an IP address in conjunction with a port number.
- The three-way handshake is a synchronization process. Sequence numbers and ACK are used to establish connections.