

4.4 STATE TRANSITION DIAGRAM

To observe the events happening during connection establishment, connection termination, and data transfer, TCP is specified as the finite state machine (FSM) as shown in Figure 4.4.1.

Here two FSMs used by the TCP client and server combined in one diagram. The rounded-corner rectangles represent the states. The transition from one state to another is shown using directed lines. Each line has two strings separated by a slash. The first string is the input, what TCP receives. The second is the output, what TCP sends.

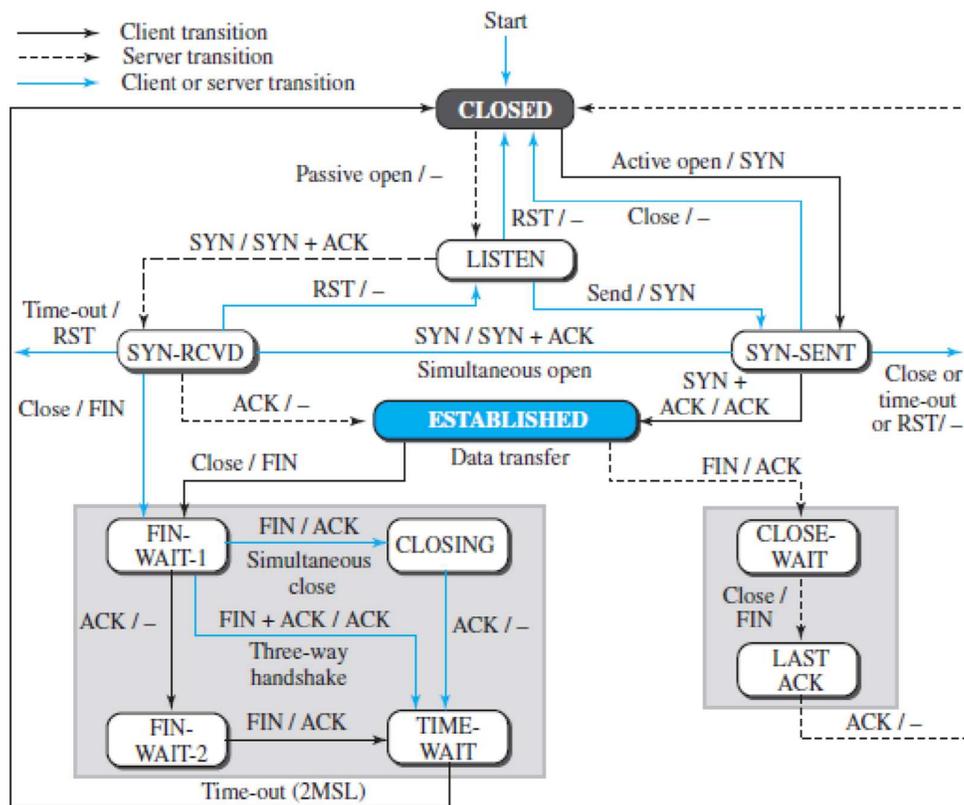


Fig4.4.1: State transition diagram.

[Source : "Data Communications and Networking" by Behrouz A. Forouzan, Page-758]

The dotted black lines in the figure represent the transition that a server normally goes through; the solid black lines show the transitions that a client normally goes through. In some situations, a server transitions through a solid line or a client transitions through a dotted line. The colored lines show special situations. The rounded-corner rectangle marked ESTABLISHED has two sets of states, a set for the client and another for the server, that are used for flow and error control.

Consider the scenario. Figure 4.4.2 shows the state transition diagram for this scenario. The client process issues an active open command to its TCP to request a connection to a specific socket address.

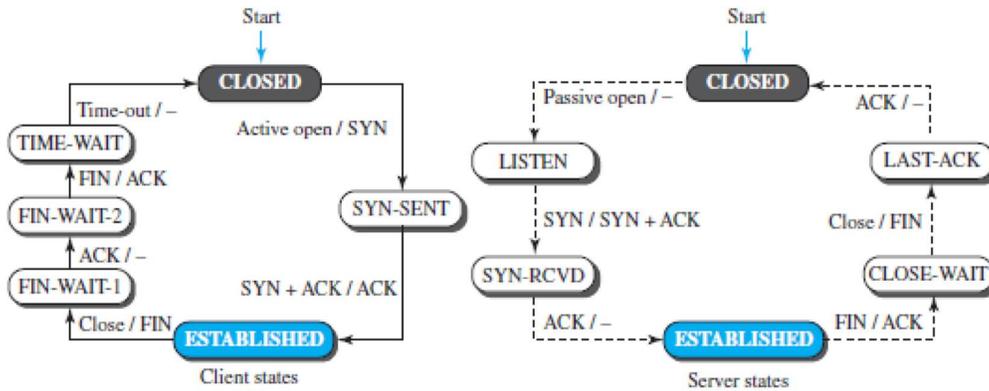


Fig4.4.2: State transition diagram.

[Source : "Data Communications and Networking" by Behrouz A. Forouzan, Page-759]

TCP sends a SYN segment and moves to the SYN-SENT state. After receiving the SYN +ACK segment, TCP sends an ACK segment and goes to the ESTABLISHED state. Data are transferred, possibly in both directions, and acknowledged. When the client process has no more data to send, it issues a command called an active close. The TCP sends a FIN segment and goes to the FINWAIT-1 state. When it receives the ACK segment, it goes to the FIN-WAIT-2 state. When the client receives a FIN segment, it sends an ACK segment and goes to the TIME-WAIT state. The client remains in this state for 2 MSL. MSL is the maximum time a TCP segment is expected to live, or stay in the network. When the corresponding timer expires, the client goes to the CLOSED state. The server process issues a passive open command. The server TCP goes to the LISTEN state and remains there passively until it receives a SYN segment.

The TCP then sends a SYN +ACK segment and goes to the SYN-RCVD state, waiting for the client to send an ACK segment. After receiving the ACK segment, TCP goes to the ESTABLISHED state, where data transfer can take place. TCP remains in this state until it receives a FIN segment from the client signifying that there are no more data to be exchanged and the connection can be closed. The server, upon receiving the FIN segment, sends all queued data to the server with a virtual EOF marker, which means that the connection must be closed.

It sends an ACK segment and goes to the CLOSEWAIT state, but postpones acknowledging the FIN segment received from the client until it receives a passive close command from its process.

After receiving the passive close command, the server sends a FIN segment to the client and goes to the LASTACK state, waiting for the final ACK. When the ACK segment is received from the client, the server goes to the CLOSE state.