



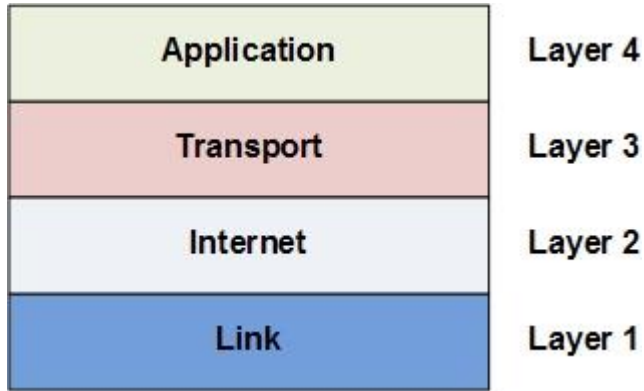
Center for Career Development

by LINKgroup

Java Networking Essentials

TCP/IP Model

- In line with modern network implementations
- Less rigid than the OSI model: many protocols can be considered in grey areas, between one area and another



TCP/IP Layer 1 - The Link Layer

- Physical and data link layer functions into a single layer
- Modulation
- Frame synchronization
- Error detection
- LLC, MAC sublayer functions
- Common protocols: Address Resolution Protocol (ARP), Neighbor Discovery Protocol (NDP)

TCP/IP Layer 2 - The Internet Layer

- Network layer of the OSI model
- Traffic routing
- Traffic control
- Fragmentation
- Logical addressing
- Common protocols: IP, ICMP, IGMP

TCP/IP Layer 3 - The Transport Layer

- The same named layer in the OSI model
- Message segmentation
- Acknowledgements
- Error detection and correction (resends)
- Message reordering to ensure message sequence
- Common protocols: Transport Control Protocol (TCP), User Datagram Protocol (UDP)

TCP/IP Layer 4 – The Application Layer

- Session, presentation and application layers of the OSI model
- Handles process-to-process communication functions:
 - Session establishment, maintenance and termination
 - Character code translations, data conversion, compression and encryption
 - Remote access
 - Network management
 - Electronic messaging
- Common protocols: TLS, SSL, FTP, DNS, HTTP, SMTP

IPv4

32 bits for the Internet addresses

2^{32} IP addresses in total — around 4.29 billion

Format: a.b.c.d - a, b, c and d are range 0 to 255

Example: 192.168.1.6

IPv6

128-bit Internet addresses

2^{128} Internet addresses

Hexadecimal system to display the addresses

Format: a:b:c:d:e:f:g:h - a, b, c, d, e, f, g and h are range from 0000 to ffff

Special Addresses

Address	Meaning
127.0.0.1	Loopback address (the host own address)
255.255.255.255	Broadcast (sent to all interfaces on a network)

Port Numbers

- 16-bit unsigned integer: 0 to 65535
- Process binding:
 - an IP address
 - a transport protocol
 - a port number
- Port conflicts: multiple programs attempt to use the same port number on the same IP address

Sockets

- Network socket: internal endpoint for sending or receiving data within a node on a computer network.
- A representation of this endpoint in networking software (protocol stack): an entry in a table.

Java Classes for IP Addresses and Sockets

- IP address represented by `java.net.InetAddress`
- Subclasses:
 - `Inet4Address`
 - `Inet6Address`

InetSocketAddress

- Represents an IP address and a port number
- Subclass of the `java.net.SocketAddress` abstract class

The TCP Protocol

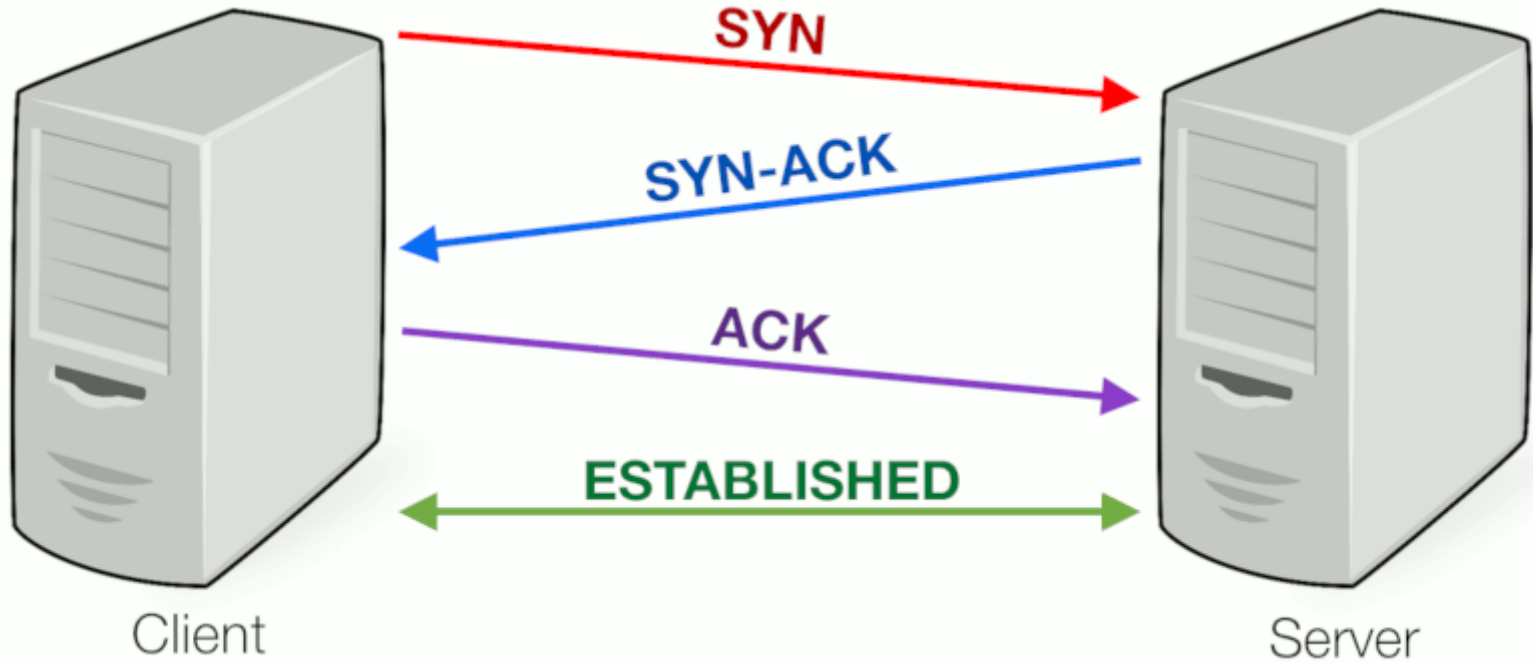
- TCP (Transmission Control Protocol) - connection-based protocol
- Provides a reliable flow of data between two computers
- Provides a point-to-point channel for applications that require reliable communications

Transfer a Web-site from Server to Client through TCP

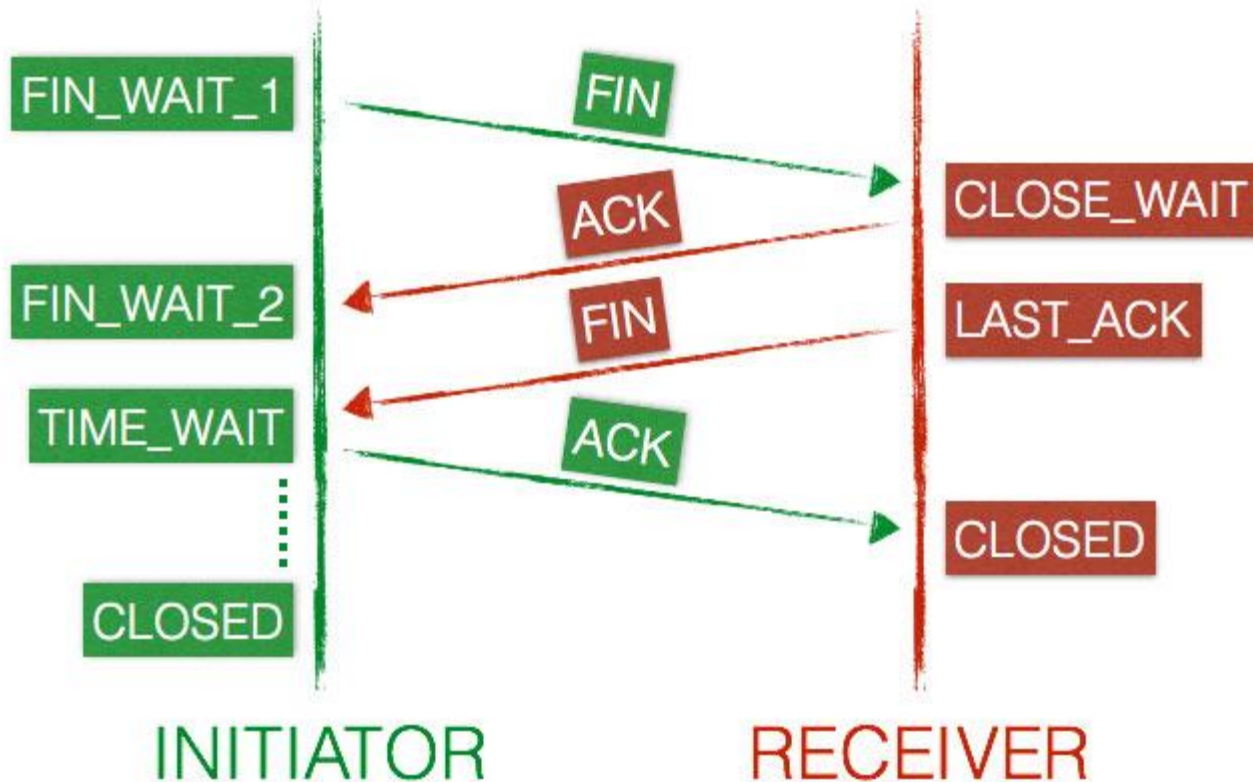


Transport Layer

TCP 3-Way Handshake



TCP 4-Way Disconnect



Socket Programming

- Establish TCP connection between two computers with sockets:
 - Server instantiates a `ServerSocket` with the port number.
 - Server invokes the `accept()` method of the `ServerSocket` class - wait until a client connects to the server on the given port.
 - Client instantiates a `Socket`, attempting to connect to the specified server and the port number.
 - On the server side, the `accept()` method returns a reference to a new socket, to be connected to the client socket.