TCP/IP Protocol

TCP/IP, or the Transmission Control Protocol/Internet Protocol, is a suite of communication protocols used to interconnect network devices on the internet. TCP/IP can also be used as a communications protocol in a private computer network (an intranet or an extranet).

The entire Internet Protocol suite -- a set of rules and procedures -- is commonly referred to as TCP/IP. TCP and IP are the two main protocols, though others are included in the suite.

TCP/IP specifies how data is exchanged over the internet by providing end-to-end communications that identify how it should be broken into packets, addressed, transmitted, routed and received at the destination. TCP/IP requires little central management, and it is designed to make networks reliable, with the ability to recover automatically from the failure of any device on the network.

The two main protocols in the Internet Protocol suite serve specific functions. TCP defines how applications can create channels of communication across a network. It also manages how a message is assembled into smaller packets before they are then transmitted over the internet and reassembled in the right order at the destination address.

IP defines how to address and route each packet to make sure it reaches the right destination. Each gateway computer on the network checks this IP address to determine where to forward the message.

Common protocols of TCP/IP include the following:

- HTTP (Hyper Text Transfer Protocol) handles the communication between a web server and a web browser.
- HTTPS (Secure HTTP) handles secure communication between a web server and a web browser.
- FTP (File Transfer Protocol) handles transmission of files between computers.

How TCP/IP works

TCP/IP uses the client-server model of communication in which a user or machine (a client) is provided a service (like sending a webpage) by another computer (a server) in the network.

Collectively, the TCP/IP suite of protocols is classified as stateless, which means each client request is considered new because it is unrelated to previous requests. Being stateless frees up network paths so they can be used continuously.

The transport layer itself, however, is stateful. It transmits a single message, and its connection remains in place until all the packets in a message have been received and reassembled at the destination.

The TCP/IP model differs slightly from the seven-layer Open Systems Interconnection (OSI) networking model designed after it. The OSI reference model defines how applications can communicate over a network.

TCP/IP model layers

TCP/IP functionality is divided into four layers, each of which include specific protocols:

- **The application layer** provides applications with standardized data exchange. Its protocols include the HTTP, FTP, Post Office Protocol 3 (POP3), Simple Mail Transfer Protocol (SMTP) and Simple Network Management Protocol (SNMP). At the application layer, the payload is the actual application data.
- **The transport layer** is responsible for maintaining end-to-end communications across the network. TCP handles communications between hosts and provides flow control, multiplexing and reliability. The transport protocols include TCP and User Datagram Protocol (UDP), which is sometimes used instead of TCP for special purposes.
- **The network layer**, also called the internet layer, deals with packets and connects independent networks to transport the packets across network boundaries. The network layer protocols are the IP and the Internet Control Message Protocol (ICMP), which is used for error reporting.
- **The physical layer**, also known as the network interface layer or data link layer, consists of protocols that operate only on a link -- the network component that interconnects nodes or hosts in the network. The protocols in this lowest layer include Ethernet for local area networks (LANs) and the Address Resolution Protocol (ARP).

Importance of TCP/IP

TCP/IP is nonproprietary and, as a result, is not controlled by any single company. Therefore, the Internet Protocol suite can be modified easily. It is compatible with all operating systems, so it can communicate with any other system. The Internet Protocol suite is also compatible with all types of computer hardware and networks

TCP/IP is highly scalable and, as a routable protocol, can determine the most efficient path through the network. It is widely used in current internet architecture.

The ***advantages of using the TCP/IP*** model include the following:

- helps establish a connection between different types of computers;
- works independently of the operating system;
- supports many routing protocols;
- has client-server architecture that is highly scalable;
- can be operated independently;
- supports several routing protocols.

The **disadvantages of TCP/IP** include the following:

- complicated to set up and manage;
- transport layer doesn't guarantee delivery of packets;
- not easy to replace protocols in TCP/IP;
- doesn't clearly separate the concepts of services, interfaces and protocols, so not good for describing new technologies in new networks; and
- especially vulnerable to a SYN (synchronization) attack, which is a type of denial-of-service attack in which a bad actor uses TCP/IP protocol.
