What is TCP/IP?

TCP/IP stands for Transmission Control Protocol/Internet Protocol and is a suite of communication protocols used to interconnect network devices on the internet. TCP/IP is also used as a communications protocol in a private computer network -- an intranet or extranet.

The entire IP 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. The TCP/IP protocol suite functions as an abstraction layer between internet applications and the routing and switching fabric.

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 is designed to make networks reliable with the ability to recover automatically from the failure of any device on the network.

Internet Protocol Version 4 (IPv4) is the primary version used on the internet today. However, due to a limited number of addresses, a newer protocol known as IPv6 was developed in 1998 by the Internet Engineering Task Force (IETF). IPv6 expands the pool of available addresses from IPv4 significantly and is progressively being embraced.

How are TCP and IP different?

The two main protocols in the IP suite serve specific functions and have numerous differences. The key differences between TCP and IP include the following:

TCP

It ensures a reliable and orderly delivery of packets across networks.

TCP is a higher-level smart communications protocol that still uses IP as a way to transport data packets, but it also connects computers, applications, web pages and web servers.

TCP understands holistically the entire stream of data that these assets require to operate and it ensures the entire volume of data needed is sent the first time.

TCP defines how applications can create channels of communication across a network.

It manages how a message is assembled into smaller packets before they're transmitted over the internet and reassembled in the right order at the destination address.

TCP operates at Layer 4, or the transport layer, of the Open Systems Interconnection (OSI model).

TCP is a connection-oriented protocol, which means it establishes a connection between the sender and the receiver before delivering data to ensure reliable delivery.

As it does its work, TCP can also control the size and flow rate of data. It ensures that networks are free of any congestion that could block the receipt of data. An example is an application that wants to send a large amount of data over the internet. If the application only used IP, the data would have to be broken into multiple IP packets. This would require multiple requests to send and receive data, as IP requests are issued per packet.

With TCP, only a single request to send an entire data stream is needed; TCP handles the rest.

TCP runs checks to ensure data is delivered. It can detect problems that arise in IP and request retransmission of any data packets that were lost.

TCP can reorganize packets so they're transmitted in the proper order. This minimizes network congestion by preventing network bottlenecks caused by out-of-order packet delivery.

IP

IP is a low-level internet protocol that facilitates data communications over the internet.

IP delivers packets of data that consist of a header, which contains routing information, such as the source and destination of the data and the data payload itself.

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

IP is limited by the amount of data it can send. The maximum size of a single IP data packet, which contains both the header and the data, is between 20 and 24 bytes. This means that longer strings of data must be broken into multiple data packets that have to be sent independently and then reorganized into the correct order.

It provides the mechanism for delivering data from one network node to another.

IP operates at Layer 3, or the network access layer, of the OSI model.

IP is a connection-less protocol, which means it doesn't guarantee delivery nor does it provide error checking and correction.

Other components in a TCP/IP network

Other components present in a TCP/IP network include subnet masks, network address translation (NAT) and various protocols.

A subnet mask tells a computer, or other network device, what portion of the IP address is used to represent the network and what part is used to represent hosts, or other computers, on the network. A NAT is the virtualization of IP addresses. It helps improve security and decrease the number of IP addresses an organization needs.

Common TCP/IP protocols include the following:

Hypertext Transfer Protocol. HTTP handles the communication between a web server and a web browser.

HTTP Secure. HTTP Secure handles secure communication between a web server and a web browser.

File Transfer Protocol. FTP handles transmission of files between computers.

Domain name system. DNS translates domain names into IP addresses.

Simple mail transfer protocol. SMTP is used for email communications and is responsible for the transmission of emails between mail servers.

User datagram protocols. UDP is a connectionless protocol that offers faster but less dependable data delivery. It's widely used in real-time applications such as video streaming and online gaming.

How does TCP/IP work?

TCP/IP uses the client-server model of communication in which a user or machine -- a client -- is provided a service, such as 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's 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 OSI networking model designed after it. The OSI reference model defines how applications can communicate over a network.