

Network Fundamentals

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▼ Fundamentals

Network - A group of interconnected computer & peripherals capable of sharing software & hardware resources between users.

▼ What is TCP/IP

TCP/IP is a data link protocol. It is a model used for the World Wide Web for providing network communications which are composed of 4 layers that work together. (ATIN)

▼ TCP/IP Fundamentals

The communication between computers on a network occurs through protocol suites, with the TCP/IP protocol suite being the most widely used. TCP/IP consists of four layers: Application Layer, Transport Layer, Internet or Network Layer, and Network Interface Layer.

1. **Application Layer:** This layer formats the data to be read by the destination computer and defines the application being used. Examples of protocols at this layer include HTTP for web browsing and FTP for file transfer.
2. **Transport Layer:** Identifies the application for which the data belongs and provides end-to-end data transfer using port numbers. It adds a header to the original data, either TCP or UDP, containing source and destination port numbers.
3. **Internet Layer:** Responsible for routing packets across networks using the Internet Protocol (IP). It adds a header to the segment containing source and destination IP addresses.
4. **Network Interface Layer:** Encodes and transmits data over the network communication media. It operates at the physical level, adding a header and trailer, including MAC addresses, for transmission over Ethernet.

| Ethernet Header | IP Header | TCP or UDP | Data | Trailer |

When a packet reaches the destination computer, it is stripped of its frame header and trailer, revealing the IP header. (When you connect via Ethernet)

| IP Header | TCP or UDP | Data |

The destination computer then strips off the IP header to access the Transport Layer header and identify the application for which the data is intended.

| TCP or UDP | Data |

Finally, the transport layer header is removed, and the data is delivered to the relevant application for processing.

| Data |

▼ TCP/IP Communication

The transport layer is responsible for managing the reliability requirements of communication between hosts on a network. TCP/IP provides two transport layer protocols: TCP and UDP.

- TCP is a reliable transport protocol that ensures data delivery through acknowledged transmission, tracking, and retransmission of segments. It breaks messages into segments, numbers them for sequencing, and reassembles them at the receiving end. TCP is used by applications like FTP and HTTP, but its reliability mechanisms introduce overhead and potential delays.
- UDP, on the other hand, is an unreliable protocol that delivers data segments between applications with minimal overhead and no acknowledgements. It is suitable for applications where reliability is less critical, such as real-time streaming or online gaming.

Overall, there's a trade-off between reliability and overhead in network communication. While TCP provides robustness, it can burden network resources, whereas UDP offers simplicity and efficiency but lacks reliability mechanisms. The choice between TCP and UDP depends on the specific requirements of the application and the importance of data reliability.

▼ Internet Protocol

IP (Internet Protocol) was designed with low overhead, focusing solely on delivering packets from a source to a destination over interconnected networks. It operates with the following characteristics:

1. **Connectionless:** No prior connection is established with the destination before sending a data packet.
2. **Best Effort:** Delivery of packets is not guaranteed, meaning there is no assurance of delivery.
3. **Media Independent:** Operation is independent of the medium carrying the data, allowing it to work across various network types.

An IPv4 packet header contains essential information about the packet, with the most crucial fields being the source and destination IP addresses. IP addresses serve as unique identifiers for hosts on the internet, akin to street addresses or telephone numbers. Each IP address comprises four numbers separated by dots, with each number ranging from 0 to 255.

In essence, IP serves the fundamental function of routing packets across networks, allowing communication between devices on the internet.

▼ Loopback Interface

The loopback interface is a virtual network interface used by computers to communicate with themselves. It's primarily utilized for diagnosis, troubleshooting, and connecting to servers running locally. Loopback interfaces are always active regardless of the status of physical interfaces. The loopback address, typically represented by the IP number 127.0.0.1, is designated for this purpose. It's commonly associated with hostnames like "localhost" or "loopback."