Computer Network

Network Model

2. TCP/IP Protocol Architecture Model

The OSI model describes an idealized network communications with a family of protocols. TCP/IP does not correspond to this model directly. TCP/IP either combines several OSI layers into a single layer, or does not use certain layers at all. The following table shows the layers of the Solaris implementation of TCP/IP. The table lists the layers from the topmost layer (application) to the lowest (physical network).

Table : TCP/IP Protocol Stack

OSI Ref. Layer No.	OSI Layer Equivalent	TCP/IP Layer	TCP/IP Protocol Examples
5,6,7	Application, session, presentation	Application	NFS, NIS+, DNS, `telnet`, `ftp`, `rlogin`, `rsh`, `rcp`, RIP, RDISC, SNMP, and others
4	Transport	Transport	TCP, UDP
3	Network	Internet	IP, ARP, ICMP
2	Data link	Data link	PPP, IEEE 802.2
1	Physical	Physical network	Ethernet (IEEE 802.3) Token Ring, RS-232, others

The table shows the TCP/IP protocol layers. Also shown are the OSI Model equivalents with examples of the protocols that are available at each level of the TCP/IP protocol stack. Each host that is involved in a communication transaction runs a unique implementation of the protocol stack.

- The TCP/IP model is **Industrial model**
- The TCP/IP model was developed prior to the OSI model.
- The TCP/IP model is not exactly similar to the OSI model.
- The TCP/IP model consists of five layers: the application layer, transport layer, network layer, data link layer and physical layer.
- The first four layers provide physical standards, network interface, internetworking, and transport functions that correspond to the first four layers of the OSI model and these four layers are represented in TCP/IP model by a single layer called the application layer.
- TCP/IP is a hierarchical protocol made up of interactive modules, and each of them provides specific functionality.

TCP/IP's Layer

Physical Network Layer

The physical network layer specifies the characteristics of the hardware to be used for the network. For example, physical network layer specifies the physical characteristics of the communications media. The physical layer of TCP/IP describes hardware standards such as IEEE 802.3, the specification for Ethernet network media, and RS-232, the specification for standard pin connectors.

Data-Link Layer

The data-link layer identifies the network protocol type of the packet, in this instance TCP/IP. The data-link layer also provides error control and "framing." Examples of data-link layer protocols are Ethernet IEEE 802.2 framing and Point-to-Point Protocol (PPP) framing.

Internet Layer

This layer, also known as the network layer, accepts and delivers packets for the network. This layer includes the powerful Internet Protocol (IP), the Address Resolution Protocol (ARP), and the Internet Control Message Protocol (ICMP).

IP Protocol

The IP protocol and its associated routing protocols are possibly the most significant of the entire TCP/IP suite. IP is responsible for the following:

- **IP addressing** – The IP addressing conventions are part of the IP protocol. It is unique
- **Host-to-host communications** – IP determines the path a packet must take, based on the receiving host's IP address.

- **Packet formatting** – IP assembles packets into units that are known as **IP datagrams**.

- **Fragmentation** – If a packet is too large for transmission over the network media, IP on the sending host breaks the packet into smaller fragments. IP on the receiving host then reconstructs the fragments into the original packet.

Previous releases of the Solaris operating environment implement version 4 of the Internet Protocol, which is abbreviated as IPv4. However, because of the rapid growth of the Internet, a new Internet Protocol was created. The new protocol increases address space. This new version, known as version 6, is abbreviated as IPv6. The Solaris operating environment supports both versions, which are described in this book. To avoid confusion when addressing the Internet Protocol, one of the following conventions is used:

- When the term IP is used in a description, the description applies to both IPv4 and IPv6.
- When the term IPv4 is used in a description, the description applies only to IPv4.
- When the term IPv6 is used in a description, the description applies only to IPv6.

ARP Protocol

The Address Resolution Protocol (ARP) conceptually exists between the data-link and Internet layers. ARP assists IP in directing datagrams to the appropriate receiving host by mapping Ethernet addresses (48 bits long) to known IP addresses (32 bits long).

ICMP Protocol

Internet Control Message Protocol (ICMP) detects and reports network error conditions. ICMP reports on the following:

- Dropped packets – Packets that arrive too fast to be processed
- Connectivity failure – A destination host that cannot be reached)
- Redirection – Redirecting a sending host to use another router

The ping Command contains more information on the operating system commands that use ICMP for error detection.

Transport Layer

The TCP/IP transport layer protocols ensure that packets arrive in sequence and without error, by swapping acknowledgments of data reception, and retransmitting lost packets. This type of communication is known as “end-to-end.” Transport layer protocols at this level are Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).

TCP Protocol

TCP enables applications to communicate with each other as though connected by a physical circuit. TCP sends data in a form that appears to be transmitted in a character-by-character fashion, rather than as discrete packets. This transmission consists of a starting point, which opens the connection, the entire transmission in byte order, and an ending point, which closes the connection.

TCP attaches a header onto the transmitted data. This header contains a large number of parameters that help processes on the sending machine connect to peer processes on the receiving machine.

TCP confirms that a packet has reached its destination by establishing an end-to-end connection between sending and receiving hosts. TCP is therefore considered a “reliable, connection-oriented” protocol.

UDP Protocol

UDP, the other transport layer protocol, provides datagram delivery service. UDP does not verify connections between receiving and sending hosts. Because UDP eliminates the processes of establishing and verifying connections, applications that send small amounts of data use UDP rather than TCP.

Application Layer

The application layer defines standard Internet services and network applications that anyone can use. These services work with the transport layer to send and receive data. Many application layer protocols exist. The following list shows examples of application layer protocols:

- Standard TCP/IP services such as the `ftp`, `tftp`, and `telnet` commands
- UNIX "r" commands, such as `rlogin` and `rsh`
- Name services, such as NIS+ and domain name system (DNS)
- File services, such as the NFS service
- Simple Network Management Protocol (SNMP), which enables network management
- RIP and RDISC routing protocols

Exercise:

1: What is TCP/IP model?
2: How many layers in TCP/IP model?
3: What is TCP/IP protocol stack?
4: Write Comparison between TCP/IP and OSI model.