TRANSMISSION CONTROL PROTOCOL/INTERNETWORKING PROTOCOL

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Definition

- TCP/IP is a set of protocols or a protocol suite that defines how all transmissions are changed across the Internet.

- An Internet under TCP/IP operates like a single network connecting many computers of any size and any type.

- Internally, an internet is an interconnection of independent physical networks (such as LANs) linked together by internetworking devices.

TCP/IP Protocol

- The TCP/IP protocol is made up of 5 layers:
  - Physical,
  - Data Link,
  - Network,
  - Transport
  - & Application
- At the transport layer, TCP/IP defines two protocols i.e.
  - TCP (Transmission Control Protocol)
  - UDP (User Datagram Protocol)

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- At the Network Layer, the main protocol defined by TCP/IP is IP (Internetworking Protocol).

- At the Physical and Data Link Layers, TCP/IP does not define any specific protocol.

- A network in the TCP/IP internetwork can be:
  - Local Area Network (LAN)
  - Metropolitan Area Network (MAN)
  - Wide Area Network (WAN)
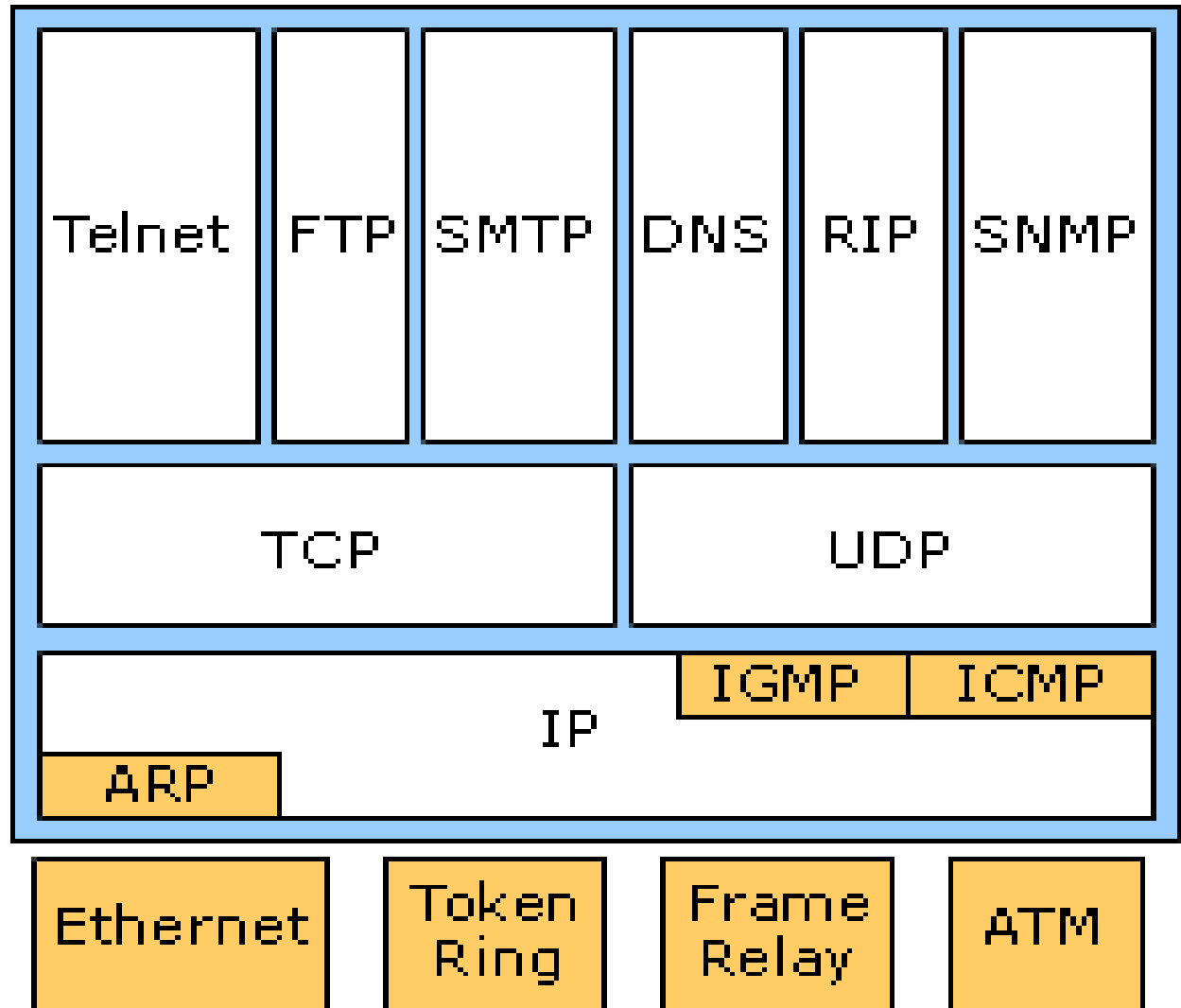
TCP/IP Protocol Architecture Layers	TCP/IP Protocol Suite
Application Layer	Telnet · FTP · SMTP · DNS · RIP · SNMP
Host-to-Host Transport Layer	TCP · UDP
Internet Layer	IP · IGMP · ICMP · ARP
Network Interface Layer	Ethernet · Token Ring · Frame Relay · ATM

Network Layer/Internet Layer

- At the Network layer, the TCP/IP supports the internetwork protocol i.e. IP which in turn contains 4 supporting protocols i.e.
  - IP
  - ARP
  - RARP
  - ICMP
  - IGMP

1. IP(Internetworking Protocol)

- IP is transmission mechanism used by TCP/IP protocols. It is an unreliable and connectionless datagram protocol. IP provides no error checking. It assumes the unreliability of underlined layers and does its best to get a transmission through its destination but with no guarantee. Noise can cause bit errors during transmission across a medium. A congested router may discard a datagram if it is unable to relay it before a time limit runs out and disabled links may leave no usable path to destination.

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- If reliability is important, IP must be paired with reliable protocol such as TCP. IP transports data in packets called *datagram*, each of which is transported separately.

- Datagrams may travel along different routes and may arrive out of sequence or duplicated. IP doesn't keep track of routes and has no facility for reordering datagram once they arrive.

- Since, it is a connection service, IP doesn't create virtual circuit for delivery.

2. Address Resolution Protocol

- The ARP associates IP address with physical address. On a typical physical network, such as LAN, each device and link is identified by physical address usually imprinted on the NIC (Network Interface Card).

- Physical addresses have local jurisdiction and can be changed easily e.g. if the NIC on a particular machine change, the physical address changes.

- On the other hand, IP addresses have universal jurisdiction and can't be changed.

- ARP is used to find physical address of the local node when the internet address is known.

- Every host on network receives or processes the ARP packet but only intended recipient recognizes its internet address and sends back its physical address.

3. RARP (Reverse Address Resolution Protocol)

- RARP allows a host to discover its internet address when it knows a physical address.

- RARP works much like ARP.

- The host wishing to retrieve its internet address, broadcasts an RARP query packet that contains its physical address to every host on its physical network.

- A server on network recognizes the RARP packet and returns the host

4. ICMP (Internet Control Message Protocol)

- ICMP is a mechanism used by hosts and routers to send notification of datagram problems back to the sender. ICMP allows IP to inform a sender if a datagram is undeliverable.

- A datagram travels from router to router until it reaches one that can deliver it to its final destination. If a router is unable to route or deliver the datagram because of unusual conditions or because of network congestion. ICMP allows it to inform the original address.

5. IGMP (Internet Group Message Protocol)

- The IP protocol can be involved in two types of communication:
  - Unicasting
  - Multicasting

- *Unicasting* is the communication between on sender and one receiver i.e. one to one communication. However, some processors sometimes need to send the same message to a large number of receivers simultaneously. This is called *Multicasting.*

- The IGMP has been designed to help a multicast router identify the host in a LAN that are members of a multicast group. It is companion to the IP protocol.

Transport Layer

- The Transport Layer is represented in TCP/IP by two protocols:
  - TCP
  - UDP
- The transport protocols of TCP/IP suite define a set of conceptual connections to individual processes called ports. The IP is host to host protocol means that it can deliver a packet from one physical device to another.

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- TCP/IP's transport level protocol are port to port protocols that work on top of the IP protocols to deliver the packet from the originating port to IP services at the start of the transmission and from the IP services to the destination port at the end.

- Each port is defined by a positive integer address carried in the header of the transport layer packet. The IP datagram uses the hosts 32 bit internet address. A frame at the transport level uses the process port address of 16 bits.

User Datagram Protocol (UDP)

- UDP is the simpler of the two standard TCP/IP transport protocol. It is an end-to-end transport level protocol that has only port addresses, checksum error control and length information to the data from the upper layer.

- The packet produced by UDP is called *user datagram*. Its fields are:
  - Source port address
  - Destination port address
  - Total length of the user datagram
  - Checksum for error detection

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- UDP does not provide any sequencing or reordering and cannot specify the damaged packet when reporting an error (for which it must be paired with ICMP).

Transmission Control Protocol (TCP)

- TCP provides full transport layered services to application layer. TCP is reliable port-to-port protocol. It is connection oriented i.e. a connection must be established between both ends of the transmission before either may transmit data.

- At the sending end of each transmission, TCP divides long transmissions into smaller data units and packages into a frame called a segment.

TCP Contd…

- Each segment includes a sequencing number for reordering after receipt, together with an acknowledgement ID number.

- Segments are carried across network links inside of IP datagrams.

- At the receiving end, TCP collects each datagram as it comes in and reorder the transmission based on sequence number.

Application Layer Protocols of TCP/IP

- Simple Mail Transfer Protocol (SMTP)
- Multipurpose Internet Mail Extension (MIME)
- Post Office Protocol (POP)
- File Transfer Protocol (FTP)
- Trivial File Transfer Protocol (TFTP)
- Simple Network Management Protocol (SNMP)
- Terminal Network (TELNET)
- Hypertext Transfer Protocol (HTTP)

SMTP

- The TCP/IP protocol that supports electronic mail on the internet is called SMTP. It is a system for sending messages to other computer users based on e-mail addresses. SMTP provides mail exchange between users on the same or different computers and supports:
  - Sending a single message to one or more recipients.
  - Sending messages that will include text, voice, video, graphics.
  - Sending messages to users on networks outside the Internet.

MIME & POP3

- MIME is a supplementary protocol that allows non-ASCII data to be sent through SMTP. MIME is not a mail protocol, it is only an extension to SMTP.

- POP3:- Workstations interact in SMTP ports to retrieve messages by using a client-server protocol such as POP3 protocol. POP3 is used to download messages from the server.

FTP & TFTP

- FTP is precisely the tool or service you want to use when you need to retrieve a file quickly. It is the most effective when you know the exact location, file-name, directory name and internet name of remote computer system of a file. It lets you retrieve files from a large number and variety of computer systems.

- TFTP: - There are occasions when we need to simply copy a file without the name for all functionalities of the FTP protocol. TFTP is designed for these types of files.

SNMP

- SNMP is a framework for managing devices in an internet using the TCP/IP protocol.

- It provides a set of fundamental operations for monitoring and maintaining the Internet. It is an application level protocol in which a few manager station control a set of agents.

TELNET

- Through telnet, the Internet user at one site (local site) could access facilities, software or data at another site (remote site). When you use telnet on your computer to contact another computer system on the internet, it is as you are directly connected to remote system. Some sites require a log-in name and a password while other's not.

HTTP

- HTTP protocol is a protocol used mainly to access data on the world wide web (www). It transfers data in the form of plain text, hypertext, audio, video and so on.

Thanks