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DEPARTMENT OF SOFTWARE ENGINEERING

Computer Networks

Lecture [9]: Description of TCP/IP Layers

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(Lecturer)

Topics discussed in Today's Lectures

- Physical Layer
- Data Link Layer
- Network Layer
- Transport Layer
- Application Layer

Physical Layer

- Physical layer is responsible for carrying individual bits in a frame across the link
- Communication b/n two devices at the physical layer is a logical comm.
  - Because there is another, hidden layer, *the transmission media*, under the physical layer
- Two devices are connected by a transmission medium (cable or air)
- Transmission medium does not carry bits; it carries electrical or optical signals
- Bits received in a frame from data-link layer are transformed into signals & sent through transmission media

Data-link Layer

- Internet is made up of several links (LANs and WANs) connected by routers
- There may exist overlapping sets of links that a datagram can travel from host to destination
- Routers are responsible for choosing the best links
- ***Data-link layer is responsible for taking the datagram(packet) and moving it across the link***
- Link can be a wired LAN with a link-layer switch, a wireless LAN, a wired WAN, or a wireless WAN
- In each case, data-link layer is responsible for moving the packet through the link

Data-link Layer (Contd…)

- TCP/IP does not define any specific protocol for the data-link layer
- It supports all the standard protocols
  - Any protocol that can take the datagram and carry it through the link
- Data-link layer takes a datagram and encapsulates it in a packet called a Frame
- Some link-layer protocols provide:
  - complete error detection and correction
  - some provide only error correction

Network Layer

- Network layer is responsible for creating a connection b/w source & destination computer
- Communication at the network layer is host-to-host
- There can be several routers from source to destination, ***routers*** *in the path are responsible for choosing best route for each packet*
- Network layer is responsible for *routing the packet through possible routes*
- The network layer in the Internet includes the main protocol, Internet Protocol (IP), that defines *format of the packet, called a datagram at the network layer*

Network Layer (Contd…)

- IP also defines the format and the structure of addresses used in this layer
- IP is also responsible for:
  - Routing a packet from its source to its destination, which is achieved by each router
  - Forwarding datagram to next router in its path
- IP is a connectionless protocol that provides no flow control, no error control, and no congestion/jamming control services (duties of transport-layer protocol)
- A Routing Protocol does not take part in routing (it is the responsibility of IP), but it creates forwarding tables for routers to help them in the routing process

Network Layer (Contd…)

- Network layer also has some supporting protocols that help IP in its delivery & routing tasks
- Internet Control Message Protocol (ICMP) helps IP to report some problems when routing a packet
- Internet Group Management Protocol (IGMP) helps IP in multitasking
- Dynamic Host Configuration Protocol (DHCP) helps IP to get the network-layer address for a host
- Address Resolution Protocol (ARP) helps IP to find the link-layer address of a host

Transport Layer

- Logical connection at the transport layer is also end-to-end
- Transport layer at the source host:
  - Gets the message from the application layer
  - Encapsulates message in a transport layer packet (called a segment or a user datagram)
  - Sends it, through logical (imaginary) connection, to transport layer at destination host
- Transport layer is responsible for giving services to the application layer:
  - To get a message from an application program running on source host
  - Deliver it to corresponding application program on the destination host

Transport Layer (Contd…)

- There are >1 protocol in the transport layer, which means that each application program can use the protocol that best matches its requirement
- Main protocol, Transmission Control Protocol (TCP), is a connection-oriented protocol that 1st establishes logical connection b/n transport layers at 2 hosts before transferring data
- TCP provides:
  - Flow control (matching sending data rate of source host with the receiving data rate of the destination host to prevent disturbing the destination)
  - Error control (to guarantee that the segments arrive at the destination without error and resending the corrupted ones)
  - Congestion control to reduce the loss of segments due to congestion in the network

Transport Layer (Contd…)

- User Datagram Protocol (UDP), is a connectionless protocol that transmits user datagrams without first creating a logical connection
- In UDP, each user datagram is an independent entity without being related to the previous or the next one
- UDP is a simple protocol that does not provide flow, error, or congestion control
- Its simplicity, which means small overhead, is attractive to an application program that needs to:
  - *Send short messages*
  - *Cannot afford the retransmission of packets* involved in TCP, when a packet is corrupted or lost
- A new protocol, Stream Control Transmission Protocol (SCTP) is designed to respond to new applications that use multimedia

Application Layer

- Logical connection between the two application layers is end-to-end
- Two application layers exchange messages b/n each other as though there were a bridge b/n the two layers
- Communication at the application layer is between two processes (two programs running at this layer)
- To communicate, a process sends a request to the other process and receives a response
- Process-to-process communication is the duty of the application layer
- Application layer in Internet includes many predefined protocols, but a user create a pair of processes to be run at the two hosts

Application Layer (Contd…)

- Hypertext Transfer Protocol (HTTP) is a vehicle for accessing the World Wide Web (WWW)
- Simple Mail Transfer Protocol (SMTP) is used in electronic mail service
- File Transfer Protocol (FTP) is used for transferring files from one host to another
- Terminal Network (TELNET) and Secure Shell (SSH) are used for accessing a site remotely
- Simple Network Management Protocol (SNMP) is used by an administrator to manage the Internet at global and local levels
- Domain Name System (DNS) is used by other protocols to find the network-layer address of a computer
- Internet Group Management Protocol (IGMP) is used to collect membership in a group

References

Chapter 2

Data Communication and Networking (5th Edition)
By Behrouz A. Forouzan

THANKS