Computer Networks

BCST -502 BCSP- 502

B.Tech (CSE) 5th Semester

Course Instructor: Dr Bishwajeet Pandey

New 2020 Syllabus

Unit –I

Computer Network: Definitions, goals, components, Architecture, Classifications & Types.Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, ConnectionOriented & Connectionless Services, Service primitives, Design issues & its functionality. ISOOSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations

Unit-II

Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary &Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP

Unit-III

MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and Slotted- ALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), CollisionFree Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.

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Unit-IV

Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least CostRouting algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing,Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding,Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6

Unit-V

Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, CarryingUnicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of DataTransfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP TimerManagement. Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).

About Course Instructor

- PhD from Gran Sasso Science Institute, Italy
- PhD Supervisor Prof Paolo Prinetto from Politecnico Di Torino, World Rank 13 in Electrical Engineering
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About Course Outline

- UNIT 1: Lecture No 1-4
- UNIT 2: Lecture No 5-11 (Including Lab on Vivado)
- UNIT 3: Lecture No 14-18
- UNIT 4: Lecture No 19-21, Lecture 12-13
- UNIT 5: Lecture No 22-28 (Including Lab on Packet Tracer)
- Lecture No 29-35: Discuss Previous Year Question of UKTU
- Out of 35 Lectures: Some will delivered by Professor From Foreign University

OUTLINE OF LECTURE 19

- Need of Network Layers
- Service Provided by Network Layer
- Design Issues in Network Layer

Need of Network Layers

- Main responsibility of Network layer is to carry the data packets from the source to the destination without changing or using it.
- If the packets are too large for delivery, they are fragmented i.e., broken down into smaller packets.
- It decides the root to be taken by the packets to travel from the source to the destination among the multiple roots available in a network (also called as **routing**).
- The source and destination addresses are added to the data packets inside the network layer.

Service Provided by Network Layer

- The **network layer provides services** to direct packets to a destination host on another **network**.
- The role of the router is to select paths for and direct packets toward the destination host in a process known as **routing**.
- A packet may cross many intermediary devices before reaching the destination host.

Service Provided by Network Layer

The **services** which are offered by the network layer protocol are as follows:

1. **Addressing**
2. **Packetizing**
3. **Fragmentation and Reassembly**
4. **Routing**
5. **Forwarding**
6. **Inter Networking**

Addressing

- Maintains the address at the frame header of both source and destination and performs addressing to detect various devices in network.

Packetizing

- The process of encapsulating the data received from upper layers of the network(also called as payload) in a network layer packet at the source and decapsulating the payload from the network layer packet at the destination is known as packetizing.

- The source host adds a header that contains the source and destination address and some other relevant information required by the network layer protocol to the payload received from the upper layer protocol, and delivers the packet to the data link layer.

Fragmentation and Reassembly

- Fragmentation is the process of breaking a packet into smaller pieces so that they will fit into the frames of the underlying network.
- The receiving system reassembles the pieces into the original packets.
- The term MTU (maximum transmission unit) refers to the maximum amount of data that can travel in a frame.
- Different networks have different MTU sizes, so packets may need to be fragmented in order to fit within the frames of the network that they transit.

Fragmentation and Reassembly

- Internetworking protocols such as IP use fragmentation because each of the networks that a packet may travel over could have a different frame size.
- Fragmentation occurs at routers that connect two networks with different MTUs.
- Fragmentation is always undesirable because it reduces performance.
- In fact, fragmentation is not allowed in IPv6. Large packets are always preferable.

Routing

- These are two other services offered by the network layer. In a network, there are a number of roots available from the source to the destination.
- The network layer specifies has some strategies which find out the best possible route.
- This process is referred to as routing. There are a number of routing protocols which are used in this process.

Routing Protocols

- Least Cost Routing algorithm
- Dijkstra's algorithm
- Bellman-ford algorithm
- Hierarchical Routing
- Broadcast Routing
- Multicast Routing

Forwarding

- Forwarding is simply defined as the action applied by each router when a packet arrives at one of its interfaces.

- When a router receives a packet from one of its attached networks, it needs to forward the packet to another attached network (unicast routing) or to some attached networks(in case of multicast routing).

Inter Networking

- It works to deliver a logical connection across multiple devices.

Design Issues in Network Layer

The network layer comes with some design issues they are described as follows:

1. **Store and Forward packet switching**
2. **Services provided to Transport Layer**
3. **Implementation of Connectionless Service**
4. **Implementation of Connection Oriented service**

Store and Forward packet switching

- The host sends the packet to the nearest router.
- This packet is stored there until it has fully arrived once the link is fully processed by verifying the checksum then it is forwarded to the next router till it reaches the destination.
- This mechanism is called “Store and Forward packet switching.”

Services provided to Transport Layer

- Through the network-transport layer interface, the network layer transfers it’s services to the transport layer. But before providing these services to the transfer layer following goals must be kept in mind
  - Offering services must not depend on router technology.
  - The transport layer needs to be protected from the type, number and topology of the available router.
  - The network addresses for the transport layer should use uniform numbering pattern also at LAN and WAN connections.

Services provided to Transport Layer

Based on the connections there are 2 types of services provided :

- **Connectionless –** The routing and insertion of packets into subnet is done individually. No added setup is required.
- **Connection-Oriented –** Subnet must offer reliable service and all the packets must be transmitted over a single route.

Implementation of Connectionless Service

- Packet are termed as “datagrams” and corresponding subnet as “datagram subnets”.
- When the message size that has to be transmitted is 4 times the size of the packet, then the network layer divides into 4 packets and transmits each packet to router via. a few protocol.
- Each data packet has destination address and is routed independently irrespective of the packets.

Implementation of Connection Oriented service

- To use a connection-oriented service, first we establishes a connection, use it and then release it.
- In connection-oriented services, the data packets are delivered to the receiver in the same order in which they have been sent by the sender
- It can be done in either two ways :
  - **Circuit Switched Connection –** A dedicated physical path or a circuit is established between the communicating nodes and then data stream is transferred.
  - **Virtual Circuit Switched Connection –** The data stream is transferred over a packet switched network, in such a way that it seems to the user that there is a dedicated path from the sender to the receiver. A virtual path is established here. While, other connections may also be using the same path.

OUTLINE OF LECTURE 20-21

- **Routing Protocols**
    - Least Cost Routing algorithm
    - Dijkstra's algorithm
    - Bellman-ford algorithm
    - Hierarchical Routing
    - Broadcast Routing
    - Multicast Routing
- **ICMP**