Computer Networks (CS30006)

Course Outline

Lecture 1:

- Brief history of networking and Internet
- Need for protocols, goals
- Organization of the course
- Outline of the course

Lecture 2:

- Topology
- Switching Techniques

Lecture 3:

- Analog and Digital transmission
- Pros and cons of analog and digital transmission
- Attenuation, Delay distortion, noise, SNR
- Channel capacity, data rate, baud rate, Nyquist's sampling theorem, Nyquist Bandwidth, Shannon capacity

Lecture 4:

- Transmission Medium
    - Media types and their basic characteristics/advantages/disadvantages – coaxial cables, twisted pairs, OFC, wireless
    - Some more details of Cat5/5e/6/7/8 and Single Mode and Multimode OFCs

Lecture 5:

- Need for synchronization, encoding, error control, flow control
- Basics of Synchronous and Asynchronous Transmission
- Data Encoding
    - Encoding digital data with digital signals:

- NRZ-L, NRZ-I, Manchester, Differential Manchester
- 4B/5B, 8B/10B

Lecture 6:

- Encoding digital data with analog signals: ASK, FSK, BPSK, QPSK
- Error Control
- Error Detection: Parity, CRC, checksum

Lecture 7:

- Stop-and-Wait
- Go-back-N
- Selective-reject ARQ

Lecture 8:

- Need for sharing
- What is needed for sharing –Medium Access Control, Addressing
- Medium Access Control
- Multiplexing techniques – FDM, TDM, Statistical TDM, WDM

Lecture 9:

- Contention-based protocols
  - Aloha
  - Slotted Aloha
  - CSMA/CD

Lecture 10:

- CSMA/CA
- Token ring

Lecture 11:

- Introduction to overall network stack of a machine
- Layering

- OSI and TCP-IP Layers

Lecture 12:

- LAN as broadcast domain
- Ethernet – history, standards, division into IEEE 802.2 and 802.x
- IEEE 802.3 – frame format, operation, sub-standards based on it
- Difference between "Ethernet" and 802.3

Lecture 13:

- Hubs and switches, spanning tree protocol
- Bridges
- Status of Ethernet as it stands today, 10G/40G/100G

Lecture 14:

IPV4 Addressing
- IP address, classes
- classless address,
- notion of subnets and subnet mask

Lecture 15:

IPV4 header
- IP header fields
- IP Routing
- Routing by the network
- Notion of gateway/router
- Example of routing table and its fields
- Basic operation of a router

Lecture 16:

- IP Fragmentation
- ICMP

Lecture 17:

- ARP and RARP

Lecture 18:

Routing Protocols
- Goals and performance metrics, difference between routing protocols and forwarding protocols
- Types – flooding, random routing, static routing, dynamic routing, their pros and cons

Lecture 19:

- Distance Vector Routing – basic operation, counting to infinity problems, basics of RIP

Lecture 20:

- Link State Routing – basic operation, basics of OSPF

Lecture 21:

- Notion of ports and connections, well-known ports, reserved ports
- Notion of streams and byte-oriented flows, basic properties of TCP like reliability, in-order etc.

Lecture 22:
- TCP header fields
- Connection establishment and termination

Lecture 23:

- TCP Congestion control – Implicit and explicit congestion detection, notion of slow start and congestion avoidance, Fast retransmit and Basic data transfer, notion of segments,
- MSS, Nagle's algorithm, timeout and retransmission,
- Karn's algorithm for RTT estimation,
- TCP state diagram

Lecture 24:

- Flow Control Techniques at Transport Layer

Lecture 25:

- UDP
- Difference between TCP and UDP

Lecture 26:

DNS

- Basic architecture and operations
- Notion of primary and secondary name servers

Lecture 27:

DNS

- Zone files and zone transfers
- Recursive and iterative queries

Lecture 28:

DHCP
- Functionalities
- Basic operation for discovering DCP servers, acquiring and renewing leases

Lecture 29:

Networking Devices

- Hub
- Switch
- Router
- Bridge
- Gateway

- Modem
- Repeater
- Access Point

Lecture 30:

- L2 Switch
- L3 Switch

Lecture 31:

- Switched Ethernet
- Working of Switch

Lecture 32:

Internet architecture and physical devices
- Basics of BGP
- Notions of AS and routing between them