IT 223: Advance Internetworking

Course Objectives

This course aims is to focus on network communication protocol.It alsoexplains the motivation of networks and provides in-depth discussion on the challenges in designing such networks from transmission system and network point of views. Further to illustrate these principles and get hands- on experience the course contains a set of lab assignments and a project.

Course Description

This course contains overview of internet network, networking layer, dynamic routing, Multicast and Multicast routing, Multimedia networking, Peer to Peer network and New Transport Layer protocols

Course Details

Unit 1: Overview of Internet and network **LH 2**

Networking, Types of networking, Internet
Seven Layers Function of OSI Model
Overview of TCP/IP model

Unit 2: Network layer **LH 4**

Network layer service
Connection oriented services,
Connection less services
Connection oriented protocols
Virtual Circuits (VC), VC forwarding table, VC signaling protocols
Connection less protocols
Issues in IP, Next hop Routing, Internet Routing tables, Longest prefix matching, IP router model, IP Forwarding, IP header in detail, Fragmentation-MTU, ICMP, ICMP error reporting, ICMP error restrictions
Router Architecture Overview
Input port functions, Type of switching fabrics (memory, bus, crossbar) in detail
Output ports, Output port queuing, Input port queuing

Unit 3: Dynamic Routing **LH 8**

Basic routing
Levels of abstraction
Partitioning: AS and areas
Autonomous systems- RFC1930
Simple internet architecture
Reachability and metrics
IP aggregation
Redistribution of routing information
Load balancing
Popular routing protocols
Distance vector

RIP(Routing Information Protocol),
RIP problem (count to infinity),
Solution (Triggered Update, split horizon, poison reserve, and hold down))
Disadvantage with RIP.
Link State Protocols
Dijkstra algorithm (shortest path first)
Overview of OSPF
OSPF Network Topology
OSPF protocols (hello, exchange, flooding)
Distribution of link state advertisement
IS-IS
Path vector
Overview of path vector
BGP (overview and architecture)
BGP router model

Unit 4: Multicast and Multicast routing **LH5**

IP multicast application
IP multicast: abstraction of hardware multicast
IP multicast service model
IP multicast addresses
Link-level/hardware multicast
Mapping IP multicast to Ethernet
IGMP
Position of IGMP in TCP\IP
IGMP V2 message
Dynamics of IGMP message
IGMP V3 overview
Multicast router
Multicast routing overview
Multicast VS multiple unicast
Delivery tree
Multicast routing protocol
Source-Based tree (DVMRP (overview, Reverse Path Multicasting, Reverse Path forwarding), MOSPF, PIM-DM)
Group shared tree (PIM-SM, CBT)

Unit 5: IPv6 **LH 7**

Overview of IPv4 (Addressing schemes IPV4)
Issues with IPv4
Overview of IPv6
IPv6 Simplification
IPv6 Header
IPv6 Addresses (IPv6 format)
IPv6 Addresses abbreviations and CIDR
IPv6 Vs IPv4
Transition from IPv4 to IPv6
Transition strategies (Dual stack, tunneling, header Translation)

Unit 6: IPQOS **LH 6**

- Congestion control algorithm
  - General Principles of congestion control, Congestion prevention policies,Congestion control in virtual circuit subnet (TCP), Congestion control in datagram subnet (UDP).
- QoS Concept
  - QoS parameters (Delay, Bandwidth, Jitter, and Reliability)
- Techniques to achieve good QoS
  - Overprovisioning, Buffering, Traffic shaping, Leaky bucket algorithm, Token bucket algorithm,Admission control, Resource reservation (RSVP)
- Functions of IPQOS(classification, policing, shaping, scheduling, admission control)
- Integrated and differentiate service
- Traffic conditioning (classifier,meter,marker, shaper/dropper)

Unit 7: Multimedia networking **LH 5**

- Multimedia applications
- Multimedia service requirement
- Classes of multimedia application
  - Streaming stored audio\video
  - Streaming live audio\video
  - Real-time interactive audio\video
- Server for stored streaming audio\video
  - Multimedia for web server
  - Multimedia for streaming server
- Real-time streaming protocol (RTSP)
  - RSTP client server interaction
  - Real-time traffic
  - Delay Jitter
  - Playback buffer
- Real-time transfer protocol (RTP)
- Content distribution networks (CDN)
  - Finding base server

Unit 8: Peer to Peer network **LH 4**

- Client/server architecture
- Peer to peer architecture
- Client/server VS peer to peer network
- History and examples of P2P
  - File sharing:-FTP, IRC, Napster, Gnutella/KaZaa/direct connect, BitTorrent
  - Non file sharing: - Skype, DNS, USENET
- P2P – peer discovering
  - Centralized, fully distributed, Hierarchical(Gossiping, Distributed Hash Tables, Super Peers)
- P2P operation
- P2P and Infrastructural

Unit 9: New Transport Layer protocols **LH 4**

Process to process Communication
Functions (addressing, ordered\unordered delivery, error control, flow control, congestion control, segment fragmentation/reassembly)
Advances in transport layer
- DCCP (datagram congestion control protocol)
  - Congestion control in DCCP
  - UDP vs. DCCP

SCTP (stream control transmission protocol)
- SCTP packet
- SCTP association and multi homing
- Implementation of Multi streaming in SCTP

LAB:-

1) Setting up Routers,
2) Dynamic IP Address assignment
3) Static and dynamic Routing
4) IPv6
5) Multicast routing
6) Multimedia networking

Project: - At the end of the semester students will work together in groups of 5 or 6 in a project to learn about and demonstrate how to setup an ISP(internet service provider). This project has to be examined by external examiner.

- ISP Requirements report: Each group should submit a report on services and functionality required to establish an ISP. The group should also comment upon the requirements report submitted by another group.
- Final report and demonstration: A final report should be written to describe some of the most desirable services an ISP should provide, including descriptions of how to this could be implemented. Some of the services should also be implemented and demonstrated by the group.

Course Book:

- J.F. Kurose, K.W. Ross: Computer Networking: A Top Down Approach

References

- B. A. Forouzan: Data Communication and Networks
- A.S Tanenbaum: Computer Networks. 4th Edition. PHI.
- D.E. Corner: Internetworking with TCP/IP. Vol.1. 3rd ed. PHI.
- S. Keshav: An Engineering Approach to Computer Networking Addison Wesley, Longman.
- W. Stalling: Data and Computer Communications. 8th Edition. PHI.
- W.R. Stevens: TCP/IP Illustrated Volume I, II and III, Addision Wesley Longman