Communication Networks

MAP-TELE

2011/12

Objective of the course

- The main objective of the course is to present the fundamentals of modern communication systems and networks and allow students to consolidate and integrate previously acquired knowledge in this area

- The course is organized around two main subjects
  - Network basic mechanisms
  - TCP/IP architecture

- The course will rely on a laboratorial component that will enable students to complement their theoretical knowledge with a set of guided experiments that will embrace the different layers and protocols of the TCP/IP architecture

Learning outcomes

- In the end, students are expected to:
  - Understand the basic mechanisms of communication networks
  - Understand the functional details of each layer of the TCP/IP architecture and their associated protocols and technologies
  - Have a general understating about the different types of networks, including their goals, architectures and the most important technologies that have been proposed to deploy them

Teaching methodology

- The course will include theoretical (T) and practical (P) / laboratorial classes
- The theoretical component will be organized as a set of modules, each one dedicated to a different topic
- Laboratorial classes will be devoted to TCP/IP networks and will consist in a set of guided experiments that will enable students to consolidate their knowledge on the different protocols and applications of the TCP/IP architecture

Syllabus

- The theoretical component of the course is organized in 3 modules

- Network basic mechanisms
  - Duration: 12 hours
  - Lecturer: José Ruela (U. Porto)
- TCP/IP architecture
  - Duration: 12 hours
  - Lecturer: Alexandre Santos (U. Minho)
- Overview of telecommunications networks
  - Duration: 8 hours
  - Lecturer: Susana Sargento (U. Aveiro)

- Practical component
  - Duration: 16 hours

Network basic mechanisms

- Introduction to communications networks
- Multiplexing (statistical, time, frequency and code division)
- Packet switching (datagrams and virtual circuits)
- Network architectures (principles of layered architectures, interfaces, protocols and services, OSI and TCP/IP)
- Framing (delineation techniques; bit, byte and character stuffing)
- Error control – error detection (simple and block parity, CRC, checksums) and ARQ recovery strategies (stop-and-wait, go-back-N, selective reject)
- Multiple access (ALOHA, CSMA, CSMA/CD, CSMA/CA, token passing)
- Flow, congestion and admission control (open-loop and closed-loop flow control; traffic contract, traffic descriptors, regulators and policers)
- Scheduling (work-conservation principle, FIFO, WRR, GPS, WFQ, packet discard methods)
- Routing (algorithms, distance vector and link state routing, adaptive routing)

TCP/IP architecture

- Application Services (Client-Server paradigm, Remote Access, File Transfer, Resource Sharing, E-Mail and the Web)
- Data Link Layer (Shared and Dedicated Media, IEEE 802.X Link Layer – Media Access Control and Logical Link Control, Ethernet – IEEE 802.3, Extended LANs)
- Transporting the Information (Naming, Addressing and Application Multiplexing, DNS/DDNS, NIS and LDAP, Transport services – TCP, UDP, RTP/RTCP)
- The Core Network (IP/ICMP, Network Addressing and Naming – ARP/RARP, DHCP and NAT/PAT, Routing – RIP, OSPF and BGP, IPv4 vs. IPv6, Unicast vs. Multicast)

Overview of telecommunications networks

- Access Networks (dialup, ADSL, HFC, CATV, Ethernet and wireless)
- Multiservice Requirements and Multiservice Networks (ATM, MPLS)
- Mobile Communications (wireless LAN/MAN, GSM, GPRS, UMTS, IMS/TISPAN)
- Broadcast Networks (MBMS)

Practical component

- The practical component of the course will take place in a networking lab and will include a set of guided experiments that include the following topics
  - Data link layer (addressing, Ethernet)
  - Network layer (ARP, addressing, IP, ICMP, DHCP)
  - Routing protocols (Spanning Tree, RIP, OSPF, BGP)
  - Transport layer (UDP, TCP)
  - Application layer (the client-server model)

Class schedule

- The course duration is twelve weeks
- Classes will be given on Thursdays (two periods of two hours)
  - Weeks 1 to 3 – Network basic mechanisms (T)
  - Weeks 4 to 10 – TCP/IP architecture (T) and laboratory assignments (P)
  - Weeks 11 and 12 – Overview of telecommunications networks (T)
- Note: Some adjustments may still be necessary
  - Classes on December 1 or 8 (holidays) will be given on the following Friday
  - Detailed schedule for weeks 4 to 10 to be decided

Examination criteria

- The evaluation of the theoretical component will consist in a written examination

- The evaluation of the practical component will based on the results of the laboratory assignments and the related reports

- The theoretical (T) and practical (P) components will contribute equally to the final grade (F)

$$F = 0.5 * T + 0.5 * P$$

Bibliography

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