

CS455 - Data Communications

Last Updated - 05/15/02

Course Manager – Dr. Peng-Jun Wan, Assistant Professor

3 credit hours; elective for CS & CPE; 150 min. lecture each week

Current Catalog Description - Introduction to data communication concepts and facilities with an emphasis on protocols and interface specifications. Focuses on the lower four layers of the ISO-OSI reference model.

Prerequisite: CS 450. (3-0-3)

Textbook

- Fred Halsall, *Multimedia Communications: Applications, Networks, Protocols and Standards*, Addison Wesley, 2001.

References - other textbooks or materials

- None

Course Goals - Students should be able to:

- Explain the operation of multi-layered protocols, particularly the OSI and Internet models / architectures and how standards evolve.
- Describe the difference between different network topologies, including packet and circuit switched, LANs and WANs, and identify and describe networks that apply to each network type.
- Explain the basic concepts of the Physical Layer: including physical media, encoding / modulation, multiplexing, error control, and their implementation in various commercial networks.
- Describe the basic operation of the Data Link Layer, including connection oriented versus connectionless protocols, retransmission algorithms, windows and flow control, and their implementations in various networks.
- Describe the basic operation of the network layer, including addressing and routing.
- Describe the basic operation of TCP/UDP, including connection establishment and release, buffered transfer, adaptive retransmission, and congestion and flow control.
- Describe LAN architectures and their implementations.
- Explain Application layer concepts, including commercial Internet protocols and client-server technologies.
- Explain special issues, including security, performance, and quality of service from a technical and ethical viewpoint.
- Tie in all above concepts to describe the global data / telecommunications network.

Prerequisites by Topic

- Operating System

Major Topics Covered in Course

1. Introduction to the course, layered protocols, and networks	4 hours
2. Physical layer	5 hours
3. LANs and Medium Access Control	5 hours
4. Data link layer	4 hours
5. Network layer (IP)	5 hours
6. Transport layer (TCP, UDP)	5 hours
7. Application layer	4 hours
8. Special issues	1 hour
9. A Complete Network Overview	3 hours
Midterm (Review, Test), Paper / Project(s) Description & Evaluation, Final Exam Review	9 hours
Final Exam	-
	45 hours

Laboratory projects (specify number of weeks on each)

- None

Estimate CSAB Category Content in Credit Hours

	CORE	ADVANCED		CORE	ADVANCED
Data Structures	0		Computer Organization and Architecture	0.5	
Algorithms	1.5	0.5	Concepts of Programming Languages	0	
Software Design	0.5				

Oral and Written Communications - Every student is required to submit at least __0__ written reports (not including exams, tests, quizzes, or commented programs) of typically __0__ pages and to make __0__ oral presentations of typically __0__ minutes duration. Include only material that is graded for grammar, spelling, style, and so forth, as well as for technical content, completeness, and accuracy.

Social and Ethical Issues - Please list the topics that address the social and ethical implications of computing covered in all course sections. Estimate the class time spent on each topic. In what ways are the students in this course graded on their understanding of these topics (e.g., test questions, essays, oral presentations, and so forth)?

- Network etiquettes.
- Networking security.

Theoretical Foundations - Please list the types of theoretical material covered, and estimate the time devoted to such coverage in contact (lecture and lab) hours.

- Graph-theoretic aspects of networks: topology, distance, connectivity, shortest path, and spanning tree. 4 hours.
- Information theoretic aspects of communications: error detection coding. 2 hours.
- Algorithms design and analyses: flow control, congestion control, medium access control, routing. 5 hours.

Problem Analysis - Please describe the problem analysis experiences common to all course sections.

- None

Solution Design - Please describe the design experiences common to all course sections.

- None

Other Course Information

- Additional Suggested Course Assignments
 - Implementations of various algorithms such as flow control and routing.
- Planned Course Enhancements (Fall 2002)

Current Catalog Description - Introduction to International Standards Organization Open System Interconnection (ISO-OSI) reference model, design issues and protocols in the physical layer, data link layer, network layer and transport layer; architectures and control algorithms of local-area networks, point-to-point networks and satellite networks; standards in network access protocols; models of network interconnection; and overview of networking and communication software. Prerequisite: CS 450. (3-0-3)

Textbook

- Larry L. Peterson and Bruce S. Davie, *Computer Networks: A Systems Approach*, Second Edition, Morgan Kaufmann Publishers, 2000.

References - other textbooks or materials.

- R. Gallager and D. P. Bertsekas, *Data Networks*, 2nd edition, Prentice-Hall, 1992.
- A. S. Tanenbaum, *Computer Networks*, 3rd edition, Prentice-Hall, 1996.
- W. Stallings, *Data and Computer Communications*, 6th edition, Prentice-Hall, 2000.

Course Goals - Students should be able to:

- Explain the networking requirements, multi-layered protocols, particularly the OSI and Internet models/architectures.
- Implement networking services in UNIX environment.
- Analyze the characteristics of various transmission media, identify the sources to signal impairment, and estimate the transmission capacity limit.
- Explain various modulation/spreading, line coding, multiplexing and framing techniques.
- Master the error detection, forward error correction, and backward error correction techniques.
- Choose proper media access control mechanisms in wired and wireless networking environment.
- Describe the bridging of multiple LANs.
- Explain circuit/packet (cell) switching mechanism, switching hardware, self-routing, and queuing disciplines.
- Describe naming, addressing and basic operations of simple internetworking.
- Explain various routing protocols including RIP and OSPF.
- Describe the basics of Global Internet including subnetting, DNS, BGP, and IPv6.
- Explain the transportation services UDP and TCP.
- Master end-to-end flow control, congestion control, and congestion avoidance techniques.
- Describe the support of quality of service.
- Explain denial of service and countermeasures.
- Apply queuing theory to evaluate networking protocols and algorithms.

Prerequisites by Topic

- Discrete mathematics and fundamentals of graph theory.
- Programming in C/C++ or java.
- Operating system.

Major Topics Covered in Course

1. Network Requirements, Architectures, and Software Implementation	3 hours
2. Transmission Media, Signal Impairment, and Fundamental Limit	1 hour
3. Line Coding, Modulation and Spreading, Multiplexing, and Framing	5 hours
4. Error Detection, Forward Error Correction, and Backward Error Correction	5 hours
5. Wired and Wireless Medium Access Control	5 hours
6. Bridging of LANs	1 hour
7. Circuit/Packet (cell) Switching, Switching Hardware, Self-Routing, and Queuing Disciplines	3 hours
8. Simple Internetworking	2 hours
9. Unicast and Multicast Routing	2 hours
10. Global Internet	2 hours
11. End-to-End Transport Services (UDP, TCP)	1 hour
12. End-to-End Flow Control, Congestion Control, and Congestion Avoidance	4 hours
13. End-to-End Support for Quality of Services	1 hour
14. Denial of Service	1 hour

15. TCP for Mobile and Wireless	2 hours
16. Performance Analysis and Queuing Theory	3 hours
17. Technology Developments and Trends, and Their Influence on Future Computer Networks	1 hour
Midterm (Review, Test)	3 hours
	45 hours

Social and Ethical Issues - Please list the topics that address the social and ethical implications of computing covered in all course sections. Estimate the class time spent on each topic. In what ways are the students in this course graded on their understanding of these topics (e.g., test questions, essays, oral presentations, and so forth)?

- Network etiquettes.
- Denial of service and networking security.

Theoretical Foundations - Please list the types of theoretical material covered, and estimate the time devoted to such coverage in contact (lecture and lab) hours.

- Graph-theoretic aspects of networks: topology, distance, connectivity, shortest path, and spanning tree. 4 hours.
- Information theoretic aspects of communications: error detection/correction coding; orthogonal coding in CDMA. 4 hours.
- Algorithms design and analyses: flow control, congestion control, medium access control, switching and routing. 10 hours.