CIS 444
Networking Design & Implementation

Text **Business Data Networks and Telecommunications 7/E 2009**
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Text – RH posted on Blackboard
Lecture notes posted on Blackboard

Course Objective and Overview:
This course is designed to give students an understanding of network design concepts. The course is rigorous. You are advised to pay careful attention to the class lectures and especially sample problems and exercises. Exam questions are based primarily on the material covered in class and are designed to test your *understanding of the underlying concepts and networking theory.* I urge you to ask questions if you don't understand. You can come during my office hours, email me or (better yet, since everyone will benefit) ask in class. *There are not any dumb questions in this course.* You have to make sure there are no vague areas in your knowledge *before* exams. A discussion board will be used for this course in which questions can be asked in this course. I will answer questions on this board for topics in class lecture and in class projects. You will be surprised at how many of your questions may be addressed in this format.

There is a lot of material in the course and it's sufficiently different from all other MIS topics that most of you will find it very confusing at first. This course deals directly with network hardware and software. We will spend significant time gaining an understanding of network theory. You will have to work hard to get an A in the class. On the other hand, many people do get an A in my class so hard work does pay off.

Course Objectives:
Describe the communication process.
Define protocol and describe how they facilitate communication.
Describe how protocols are established.
Describe the centralized and decentralized processing models.
Identify which model is used from a description of a network or application.
Describe the advantages and disadvantages of each model.
Describe the programming model that is designed to address the primary disadvantage of the distributed processing model.
Describe the effect of application location on traffic levels.
List and define the three fundamental network characteristics.
Describe client/server and peer-to-peer networks.
Define client and server.
Identify the type of network from a description.
Describe the advantages and disadvantages of each type of network.
Describe the effect of the type of network operating system on network traffic.
Define and compare broadcast and point-to-point topologies.
Distinguish between logical and physical topologies.
Distinguish between passive and active network nodes.

Describe each type of network topology.
Define hub.
Describe the advantages and disadvantages of each topology.
Identify a topology from a picture.
Describe and contrast LANs, MANs, CANs and WANs.
Identify the layers by number and by name.
Identify which layers are considered the application layers and which are considered the data transport layers.
Identify which layers are normally implemented as hardware and which are implemented as software.
Describe the advantages of breaking the model into layers.
Define peer-layer communication and describe the encapsulation process.
Identify the names of PDUs at Layers 2, 3 and 7.
Describe the functions at each layer of the model and be able to identify in which layer a particular function is implemented.
Describe periodic waves and define amplitude, frequency, phase and wavelength.
Explain the difference between analog and digital data.
Explain AM, FM and PM.
Explain multiplexing and describe FDM, TDM, Statistical TDM, CWDM and DWDM.
Describe the impairments to transmission for wired media.
Describe the physical characteristics of each of the five wired media (coax, UTP, STP, MMF and SMF). Identify which connectors are used for each type of media.
Describe the advantages and disadvantages of each type of wired media.
Identify which media would be most appropriate for a network given a description of the network.
Identify the most common type of media in use today.
Rank the media in terms of relative cost, susceptibility to EMI/RFI, and how easy it is to work with.
Explain the components of the MAC address.
Explain the scope of the MAC address.
Describe, in detail, Xon/Xoff, Polling, CSMA/CD and Token Passing MAC methods.
Describe the effect of varying traffic levels on CSMA/CD and Token Passing.
Explain the two types of data errors that occur on networks.
Describe Parity Checking, Longitudinal Redundancy Checking and Polynomial Checking.
Perform error checks using parity checking and LRC.
Explain the methods of ARQ described in the text.
Compute transmission efficiencies.
Determine optimal frame sizes.
Evaluate the relative value of different transmission services.
Explain Ethernet naming conventions.
Id Identify the media type used by 1000BASE-SX, 1000BASE-LX, 1000BASE-CX and 1000BASE-T.
Compare and contrast 1000BASE-SX and 1000BASE-LX.
entify the media type used by 100BASE-TX and 100BASE-FX.

Describe CSMA/CA.
Explain the relationship between raw data rate and real throughput and describe the reasons for the differences.
Explain each of the ratified IEEE 802.11 standards.
Explain the purpose of a site survey.
Identify the minimum recommended SNR.
Identify the purpose of RFSM tools.
Explain how channels are assigned to access points.
Describe WEP and WPA.
Explain the SSID and the role it plays in WLANs.
Explain the steps administrators can take to secure WLANs.
Explain the differences between switches and repeaters.
Explain the mechanisms that limit the size of Ethernet collision domain.
Describe the various components of a switch.
Explain how switches learn the location of nodes on the network.
Explain how switches handle unicast and broadcast frames. Given a frame's Layer 2 header and a switch's SAT, explain what actions will be taken when the frame arrives at the switch.
Explain the difference between store and forward, cut through and modified cut through switches.
Explain the difference between half- and full-duplex. Explain when full- duplex operation would be beneficial.
Explain flow control.
Explain Link Aggregation.
Explain the effects of switches and repeaters on data throughput in a network. Refer to the two figures comparing Shared and. Switched LANs.
Explain the difference between a flat and hierarchical address space.
Identify the Class of an IP address.
Identify which portions of an IP address are the network and host addresses.
Identify which IP addresses are reserved.
Explain the components of a FQDN.
Explain the IPv6 address.
Describe the advantages of IPv6.
Describe the purpose of the host file.
Make entries in a host file.
Explain how the DNS system works.
Define primary, secondary and caching only server.
Describe how the Address Resolution Protocol works.
Describe the purpose of the default gateway.
Identify the IP parameters configured on hosts and identify the purpose of each.
Explain how DHCP operates.
Explain the reasons for internetworking.
Explain the differences between a Layer 2 switch and a router.
Explain the difference between repeaters, switches, routers and gateways in terms of the OSI model.

LAN Design Project – This is a quarter long group project that designs a local area network for a 4 story building. It is a design project that gives the student an understanding of the physical layout of real networks, networking equipment, and WAN connections.

RFP Assignment – The RFP is a 3-5 page written proposal. It requests to develop a network for a company.

In Class Network Lab – Students assemble a wired network in class and setup Active Directory, Users, and software.

In Class Wireless Network Lab - Students assemble a wireless network using Cisco Access Points in class. Students will set up in Wireless Security including changing SSID, using WEP, and using WPA.

Evaluation

The final course grade will be computed from the following inputs:

LAN Design Project	**25%**	
Project Presentation	**5%**	
RFP	**10%**	
Exam 1	**16.33%**	
Exam 2	**16.33%**	**3 Tests = 50%**
Final Exam	**16.34%**	
Class Participation	**10%**	

TOTAL	**100%**	

The final course grade will be determined as follows:

90 or above	A
80-89.99	B
70-79.99	C
60-69.99	D
Less than 60%	F

Tentative Course/Detailed Schedule

Date	Scheduled
W1	Introduction to Networks and Hardware Module 1
	Panko Chapter 6
	1.1 Communication
	1.2 The evolution of modern communication systems
	From Western Union to the Current Internet

1.3 Public Switched Network Panko Chapter 7
1.4 Historical vs Current Methodology
Networking Hardware
1.5 Logical Topologies
1.6 Physical Topologies
1.7 Data Sharing
1.8 Device Sharing
1.9 The Automated Information Systems (AIS) Environment
1.10 Automated Information Systems (AIS) Terminology (Language)
1.11 An overview of hardware, software, firmware, components of AIS
1.12 Historical vs Current Technology for AIS
1.13 AIS Hardware
1.13a Components (e.g., input, output, central processing unit (CPU))
1.13b Distributed vs. Stand-Alone
1.13c Micro, Mini, Mainframe processors
1.13d Storage devices
1.14 Software
1.14a Application Software
1.14b Operating Systems
1.15 Memory
1.15a Random
1.15b Sequential
1.15c Volatile vs. Non-Volatile
1.16 Media Storage
1.16a Magnetic Remanence
1.16b Optical Remanence
1.17 Client Server vs. Peer to Peer

W2 Theoretical Network Module 2
Panko Chapter 2
2.1 The OSI Model Module 2
2.1a Physical Layer
2.1b Data Link Layer
2.1c Network Layer
2.1d Transport Layer
2.1e Session Layer
2.1f Presentation Layer
2.1g Application Layer
2.2 TCP/IP
2.3 IEEE Physical Standards
2.4 Other Protocols
Project Meetings

W3 Data Transmission Module 3
Panko Chapter 3
3.1 Circuits

3.2 Analog vs. Digital
3.3 Transmission Parameters
3.4 Data Modulation and QAM
3.5 Throughput Measures
3.6 Asynchronous vs. Synchronous
3.7 Baseband vs. Broadband
3.8 Burst Transmission
3.9 Sustained Data Rates
3.10 Multiplexing (Frequency, Time, Statistical Time Division, Wavelength Division)
3.11 Dedicated Line
Project Meetings

W4 Network Media – Guided Module 4
Network Media – Wireless Module 4
Panko Chapter 3 Panko Module C
4.1 Guided Media – Impairments (Attenuation, Thermal Noise, Crosstalk)
4.2 Unshielded Twisted Pair
4.3 Shielded Twisted Pair
4.4 Coaxial Cable
4.5 Optical Systems
4.5a Single Mode Fiber
4.5b Multi-Mode Fiber
4.6 Structured Wiring Systems
4.6a Protected Wire Line
4.7 Wireless Media Impairments
4.8 Directional vs. Omni-Directional
4.9 Line of Sight
4.10 Microwave
4.11 Radio Frequency (Bandwidth)
4.12 Infrared
4.13 Satellite (GEO, MEO, LEO)
Wireless Demo

W5 Exam 1 CAB Network Tour – Darrell Eddy
Campus Network Infrastructure Tour – Darrell Eddy

W6 Data Link Layer – Module 5
5.1 MAC Addresses (Block and Device IDs)
5.2 Media Access Control Methods
5.3 Error Detection
5.31 Parity Checking
5.32 Longitudinal Redundancy Checking (LRC)
5.33 Polynomial Checking
5.34 Cyclic Redundancy Check (CRC)
5.4 Error Correction

5.5 Transmission Efficiency
5.6 Throughput
5.7 Transfer of Information Bits (TRIB)

Ethernet Module 6
Panko Chapter 5
6.1 Cisco Three Layer Design Model
6.11 Core Layer
6.12 Distribution Layer
6.13 Access Layer
6.2 802.11 Wireless Technology
6.3 802.11 Standards
6.4 CSMS/CA
6.5 Frequency Channels (Crosstalk)
6.6 Access Point Coverage
6.6a High Power
6.6b Low Power
6.7 RF Site Survey
6.8 Frequency Hopping
6.9 Spread Spectrum Transmission
6.10 Locating Access Points
6.11 WEP and WPA
6.12 MAC Filtering
6.13 Jamming
6.14 Masking
6.15 Screening
Project Meetings

W7 Ethernet Networking Devices Module 7
Panko Chapter 4
7.1 Hubs
7.2 Bridges
7.3 Switches L2 and L3
7.4 Routers
7.5 Switch Components
7.6 Switch Operations
7.7 Broadcast vs. Unicast
7.8 Building CAM Table
7.9 Link Aggregation
7.10 Flow Control
7.11 Spanning Tree Protocol
7.12 VLAN Concepts
7.13 Dial Up
7.13 Modems
7.14 Access Servers
7.15 Dial Back

In Class Lab #1 – Guided Media Network Lab
Exam 2
Project Meetings

W8

IP Addressing Module 8
Panko Chapter 8
8 Flat vs. Hierarchical Addressing
8.1 Host Names
8.2 Types of Network Addresses
8.21 MAC Addresses
8.22 IPv4
8.23 IPv4 Address Classes
8.24 IPv6
8.3 Host Configuration
8.4 DHCP
Routing Module 9
Panko Chapter 8
9.1 Routing Basics
9.2 Access Control List
9.3 Routing Protocols
9.4 Routing Functions
9.5 Packet Forwarding
9.6 Routing Convergence
9.7 Static vs. Dynamic
9.8 Default Routes
9.9 Interior vs. Exterior Gateways
9.10 Link State vs. Distance Vectors
In Class Lab #2 – Wireless networking
Project Meetings

W9

Traffic Analysis Module 10
Panko Chapter 10
Panko Chapter 7
10.1 Traffic Profiling
10.2 Traffic Measures
10.3 VLAN Traffic
10.4 QOS
10.5 Dial Up vs. Dedicated
10.5a Dial Up Connections
10.5b Dedicated Line

Network Design Module 11
11.1 File Servers
11.2 Server Placement
11.3 Small Network Design
11.4 Medium Size Network Design

	11.5 Large Network Design 11.6 Wide Area Network Design Project Meetings In Class Lab #3 – VM Ware
W10	Access Control List – Module 12 Panko Chapter 9 12.1 Problems Solved by Access Control Lists (ACL) 12.2 Types of ACLs 12.3 ACL Syntax 12.4 Implementing ACLs 12.5 Extended ACLs 12.6 ACL List Rules
	Implementing Network Security – Module 13 Panko Chapter 7 Panko Chapter 9 13.1 Dial Up vs. Dedicated 13.2 End-to-End Access Control 13.3 Privileges (class, nodes) 13.4 Public vs. Private 13.5 Security Traffic Analysis 13.6 Line Authentication RFP Request for Proposal Due Project Meetings
W11	Final Exam Project Presentation Project Due