432: Communication Networks I – Spring, 2007

I. **Course Description:** The Internet is the dominant medium of worldwide communications, from the arrays of servers, to desktop PCs, to cell phones and PDAs. All traffic on the Internet uses the Internet Protocol (IP) for end-to-end transport. This goal of this course is to provide an introduction and overview of current IP technologies, with focus on how the Internet works, why it was designed the way it was, and where it is going.

II. **Required text:** Charles M. Kozierok, *The TCP/IP Guide*, No Starch Press, 2005.

III. **Reference text:** None.

IV. **Prerequisites:** Students are expected to know how to use the binary, decimal and hexadecimal number systems. Exposure to network layering, local area network (LAN) basics, and experience with using the Internet is assumed.

V. **Rationale for inclusion in MIT Program:** This course explains IP networking in detail. Other courses focus on lower or higher layers or general performance, systems analysis or applications. IP is used at the fundamental transport for higher layer applications and is therefore a key area of information technology. Knowledge of Internet technologies is increasingly relevant to not just to those in the IT department, but all departments and levels of management. Almost all new applications and services require some form of network connectivity, and employers need their representatives to be knowledgeable in these technologies in order to make the best business decisions. At the end of this course, students will know enough about how network protocols work so that they can evaluate new applications, services, and vendors, debug network issues, and clearly communicate with or be part of a premiere engineering team.

VI. **Course goals:** To provide students with an intermediate level of knowledge of how real networks operate.

VII. **Course Objectives:** As a result of this course students will be able to analyze and understand network traffic, familiarize themselves with the history and design of major communications protocols, be able to converse with other IT professionals about networking, and to use this knowledge to improve their job performance though more informed decision making.

VIII. **Course topics/content:**

a. Introduction, History and Overview
    i. What is the Internet
    ii. A history of the Internet
    iii. Standards bodies and major players
b. Background
    i. Circuits vs. packets
    ii. Layering and encapsulation
    iii. Packets and packet sniffing
c. Data-link Protocols
    i. PPP
    ii. Ethernet
    iii. LAN configurations
d. Internet Protocol (IP)
    i. Packet header formats
    ii. Addressing (classful, classless, private, multicast)
    iii. Subnetting and static routing
    iv. ARP and RARP
    v. Fragmentation
e. Internet Control Message Protocol (ICMP)
    i. ICMP Packet header formats
    ii. ICMP Examples
    iii. Ping
f. Internet Group Management Protocol (IGMP)
    i. IGMP packet formats
    ii. Examples
g. User Datagram Protocol (UDP)
    i. Port numbers and services
    ii. Packet header formats
    iii. Traceroute
h. Dynamic Host Configuration Protocol (DHCP)
    i. Packet formats
    ii. Message flows
i. Transmission Control Protocol (TCP)
    i. Introduction and history
    ii. Packet header formats
    iii. Interactive data flow (delayed ACKs, Nagle)
    iv. Bulk data flow state diagram
    v. Slow start and congestion avoidance
    vi. Fast retransmit and fast recovery
    vii. Timeout and retry
j. Dynamic Routing
    i. Routing Information Protocol (RIP)

ii. Open Shortest Path First (OSPF)
iii. Border Gateway Protocol (BGP)

k. Domain Name System (DNS)
   i. Architecture
   ii. Domain name registration and maintenance
   iii. Packet header formats

l. IPv6
   i. Background
   ii. Header Format
   iii. Addressing
   iv. Fragmentation
   v. ICMPv6
   vi. Routing
   vii. Coexistence and transition

m. FTP
   i. Background and History
   ii. Protocol
   iii. Examples

n. NAT
   i. Background
   ii. How It Works
   iii. NAT in Practice

IX. **Teaching methods:** Lectures, discussion, homework, exams.

X. **Type of homework and exams:** There will be four un-graded homework assignments and two exams. Students will be given one week to complete each homework assignment, unless otherwise stated. At the end of this week, the answers will be made available. Exams will be open book.

XI. **Grading criteria:**

Class Participation	5%
Midterm	45%
Final	50%

XII. **Attendance:** In accordance with the MITP attendance policy, if you miss more than two classes, your grade will be affected. If you must miss a class, please inform me as soon as possible.

XIII. **Academic integrity:** Unless otherwise noted, you are expected to work alone on assignments. If you use reference materials, please cite them appropriately. Do NOT copy anything verbatim and attempt to pass it off as your own work. You may (and are encouraged to) discuss homework with your classmates and to assist one another in solving problems.

XIV. **Instructor profile:** Michael Borella (mike@borella.net) is Vice President of Engineering at Fastmobile, Inc., a wireless technology startup company in the Chicago suburbs. He has 60 staff members reporting to him in the Chicago headquarters and Beijing offices. Previously, he was Director of Wireless R&D for UTStarcom's CDMA data business unit, where he managed the software development, system test, network management and architecture teams. Over the years, his responsibilities have included product and feature definition, product roadmaps and release schedules, standards, intellectual property development, business development, and customer interaction. Additionally, he has held positions at 3Com, IBM and ROLM, and has consulted to various high-tech companies and served as an expert witness. He has taught at a number of universities, published numerous technical papers and been granted over 60 patents. He has been recognized numerous times for his contributions to his employers' intellectual property development programs, including being named "Inventor of the Year" by 3Com in 2000, and has also been the recipient of several performance-related awards. Dr. Borella received the Ph.D. degree in Computer Science from University of California, Davis, in 1995.

This is the eighth year Dr. Borella has taught in the MITP.