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Fall 9-2004

CRT 152T.01: Router Technologies

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THE UNIVERSITY OF MONTANA—MISSOULA
COLLEGE OF TECHNOLOGY

COURSE NO: CRT 152 Router Technologies

Fall 2004

FACULTY:

Penny Jakes penny.jakes@umontana.edu **243-7804**

CREDITS: 3

OFFICE HOURS:

4-5 M-R or by appointment in office AD17A

COURSE DESCRIPTION:

Covers router theory and technologies including configurations, IOS software management, routing protocol configuration, TCP/IP, access-lists, and introduction to LAN switching.

PREREQUISITE(S):

CRT 151, and CRT 112 or
Consent of Instructor

PERFORMANCE OUTCOMES:

At completion of course, students will be able to:

1. Configure various Cisco series routers to route traffic between LANs and WANs using CLI, setup mode, backup copies, or ConfigMaker.
2. Design networks and assign static IP addresses using advanced IP addressing schemes and subnetting techniques.
3. Select IOS versions for updating router functions and be able to download these into a TFTP Server.
4. Troubleshoot hardware and configuration problems with networked routers.
5. Set up hardware and cabling to network PCs, routers, switches, and hubs for LANs and WANs.
6. Prepare network documentation: engineering journal, spreadsheets, protocol inspection tools, network monitor tools, and topologies.
7. Cooperate in engineering teams, engage in self and project management, teach-back difficult concepts to peers, and participate in presentations.

REQUIRED TEXT:

CISCO: CCNA 1 & 2 LAB
COMPANION, Cisco Press, 3rd Ed.,
2003.

RECOMMENDED TEXT:

CISCO: CCNA 1 and 2 COMPANION
GUIDE, Cisco Press, 3rd Ed., 2003.

REFERENCES:

Cisco Technical Manual(s)

SUPPLIES:

Journal, notebook, folder, disks

EVALUATION:

Assignments will be graded on a point system; total points possible will be announced at the start of each project. Quizzes and tests will also be on a point system. Total points earned will be divided by total points possible to get a percentage with grade conversion as follows:

90 - 100	A
80 - 92	B
87 - 86	C
60 - 79	D

There is **NO OPPORTUNITY for make-ups** for any in-class activities, labs, pop quizzes, or group projects. At mid-term, a day will be identified to make-up or retake a maximum of **TWO** on-line chapter tests. During the week before finals, another day will be identified to make-up or retake **TWO** more on-line chapter tests from the second half of the semester

FINAL: 15% on-line chapter quizzes
 35% pop-quizzes, labs, lab tests, homework
 20% on-line final
 15% skills final
 15% case study

ACCOMMODATION:

Eligible students with disabilities will receive appropriate accommodations in this course when requested in a timely way. Please speak with me after class or in my office. Please be prepared to provide a letter from your DSS Coordinator.

UM Coordinator: Daniel J. Burke
 243-4424
<http://www.umt.edu/dss/>

EXPECTATIONS/POLICIES:

1. Class structure will include lectures on new material, assignments, lab assignments, group discussions, research of current periodicals and Internet, review, handouts, pop quizzes, and scheduled tests. Internet and e-mail is used extensively. Course curriculum is on-line.
2. Lab time is given in class for some projects. It is expected the student will need to spend two hours of outside work for each hour in class.
3. As each project is assigned, total points possible, due date, and specific requirements will be announced.
4. **BASICS:**
 - Treat other students, the instructor, and guests with courtesy and respect.
 - Please do your best to be on-time for class.
 - If you miss or are late, get material from another student.
 - Please listen when others are speaking.
 - Discrimination and harassment of any kind will not be tolerated.
 - Any misuse of the equipment, installing own software, or unprofessional conduct will not be tolerated.
 - For the courtesy of others, put all pagers and cell phones on silent or turn them off. If you need to take a call, do so outside of the classroom
 - Do not use computers during lectures unless you are following the lecture using the on-line curriculum. Check e-mail or surf web before or after class.

COURSE OUTLINE:

- | | |
|--|--|
| <p>I. WANs and Routers</p> <p>A. WANs</p> <ol style="list-style-type: none"> 1. Introduction to WANs 2. Introduction to routers in a WAN 3. Router LANs and WANs 4. Router role in a WAN <p>B. Routers</p> <ol style="list-style-type: none"> 1. Router internal components 2. Router physical characteristics 3. Router external connections 4. Management port connections 5. Connecting console interfaces 6. Connection LAN interfaces 7. Connecting WAN interfaces | <p>II. Introduction to Routers</p> <p>A. Operating Cisco IOS Software</p> <ol style="list-style-type: none"> 1. The purpose of Cisco IOS software 2. Router user interface 3. Router user interface modes 4. Cisco IOS software features 5. Operation of Cisco IOS software <p>B. Starting a Router</p> <ol style="list-style-type: none"> 1. Initial startup of Cisco routers 2. Router LED indicators 3. Examining the initial router bootup 4. Establishing a HyperTerminal session 5. Logging into the router 6. Keyboard help in the router CLI 7. Enhanced editing commands 8. Router command history 9. Troubleshooting command line errors 10. The show version command |
| <p>III. Configuring a Router</p> <p>A. Configuring a Router</p> <ol style="list-style-type: none"> 1. CLI command modes 2. Configuring a router name 3. Configuring router passwords 4. Examining the show commands 5. Configuring a serial interface 6. Executing adds, moves, and changes 7. Configuring an Ethernet interface <p>B. Finishing the Configuration</p> <ol style="list-style-type: none"> 1. Importance of configuration standards 2. Interface descriptions 3. Configuring interface description 4. Login banners 5. Configuring message-of-the-day (MOTD) 6. Host name resolution 7. Configuring host tables 8. Configuration backup and documentation 9. Copying, editing, and pasting configurations | <p>IV. Learning about Other Devices</p> <p>A. Discovering and Connecting to Neighbors</p> <ol style="list-style-type: none"> 1. Introduction to CDP 2. Information obtained with CDP 3. Implementation, monitoring and maintenance of CDP 4. Creating a network map of the environment 5. Disabling CDP 6. Troubleshooting CDP <p>B. Getting Information about Remote Devices</p> <ol style="list-style-type: none"> 1. Telnet 2. Establishing and verifying a Telnet connection 3. Disconnecting and suspending Telnet sessions 4. Advanced Telnet operation 5. Alternative connectivity tests 6. Troubleshooting IP addressing issues |
| <p>V. Managing Cisco IOS Software</p> <p>A. Router Boot Sequence and Verification</p> <ol style="list-style-type: none"> 1. Stages of the router power-on boot sequence 2. How a Cisco device locates and loads IOS 3. Using the boot system command 4. configuration register 5. Troubleshooting IOS boot failure <p>B. Managing the Cisco File System</p> <ol style="list-style-type: none"> 1. IOS file system overview 2. IOS naming conventions 3. Managing configuration files using TFTP 4. Managing configuration files using copy and paste 5. Managing IOS images using TFTP 6. Managing IOS images using Xmodem 7. Environment variables | <p>VI. Distance Vector Routing Protocols</p> <p>A. Distance Vector routing</p> <ol style="list-style-type: none"> 1. Distance vector routing updates 2. Distance vector routing loop issues 3. Defining a maximum count 4. Eliminating routing loops through split horizon 5. Route poisoning 6. Avoiding routing loops with triggered updates 7. Preventing routing loops with holddown timers <p>B. RIP</p> <ol style="list-style-type: none"> 1. RIP routing process 2. Configuring RIP 3. Using the ip classless command |

<p>8. File system verification</p>	<p>4. Common RIP configuration issues 5. Verifying RIP configuration 6. Troubleshooting RIP update issues 7. Preventing routing updates through an interface 8. Load balancing with RIP 9. Load balancing across multiple paths 10. Integrating static routes with RIP</p> <p>C. IGRP</p> <p>1. IGRP features 2. IGRP metrics 3. IGRP routes 4. IGRP stability features 5. Configuring IGRP 6. Migrating RIP to IGRP 7. Verifying IGRP configuration 8. Troubleshooting IGRP</p>
<p>VII. TCP/IP Suite Error and Control Messages</p> <p>A. Overview of TCP/IP Error Message</p> <p>1. Internet Control Message Protocol (ICMP) 2. Error reporting and error correction 3. ICMP message delivery 4. Unreachable networks 5. Using ping to test destination reachability 6. Detecting excessively long routes 7. Echo messages 8. Destination unreachable message 9. Miscellaneous error reporting</p> <p>B. TCP/IP Suite Control Messages</p> <p>1. Introduction to control messages 2. ICMP redirect/change requests 3. Clock synchronization and transit time estimation 4. Information requests and reply message formats 5. Address mask requirements 6. Router discovery message 7. Router solicitation message 8. Congestion and flow control messages</p>	<p>VIII. Basic Router Troubleshooting</p> <p>A. Examining the Routing Table</p> <p>1. The show ip route Command 2. Determining the gateway of last resort 3. Determining route source and destination 4. Determining L2 and L3 addresses 5. Determining the route administrative distance 6. Determining the route metric 7. Determining the route next hop 8. Determining the last routing update 9. Observing multiple paths to destination</p> <p>B. Network Testing</p> <p>1. Introduction to network testing 2. Using a structured approach to troubleshooting 3. Testing by OSI layers 4. Layer 1 troubleshooting using indicators 5. Layer 3 troubleshooting using ping 6. Layer 7 troubleshooting using Telnet</p> <p>C. Troubleshooting Router Issues Overview</p> <p>1. Troubleshooting Layer 1 using show interface 2. Troubleshooting Layer 2 using show interface 3. Troubleshooting using show cdp 4. Troubleshooting using traceroute 5. Troubleshooting routing issues 6. Troubleshooting using show controllers serial 7. Introduction to debug</p>
<p>IX. Intermediate TCP/IP</p> <p>A. TCP Operation</p> <p>1. TCP operation 2. Synchronization or 3-way handshake 3. Denial of service attacks 4. Windowing and window size 5. Sequencing numbers 6. Positive ACK 7. UDP operation</p>	<p>X. Access Control Lists (ACLs)</p> <p>A. Access Control List Fundamentals</p> <p>1. What are ACLs 2. How ACLs Work 3. Creating ACLs 4. The function of a wildcard mask 5. Verifying ACLs</p> <p>B. Access Control Lists (ACLs)</p> <p>1. Standard ACLs</p>

- B. Overview of Transport Layer Ports
 - 1. Multiple conversations between hosts
 - 2. Ports for services
 - 3. Ports for clients
 - 4. Port numbering and well-known port numbers
 - 5. Example of multiple sessions between hosts
 - 6. Comparison of MAC addresses, IP addresses, and port numbers

- 2. Extended ACLs
- 3. Named ACLs
- 4. Placing ACLs
- 5. Firewalls
- 6. Restricting virtual terminal access