Lesson 3: Layer 3 Switches

At A Glance



Layer 3 switches, sometimes called IP switches, multilayer switches, or router switches, are capable of switching data between different network segments. The networks need not be similar, for example, one network might be Ethernet and the other network token ring. Layer 3 switches use a combination of network layer protocols and Layer 2 protocols to achieve this task. Since Layer 3 switches are able to use Layer 3 network protocols, they are able to route data. Basically, Layer 3 switches have the intelligence of Layer 3 routers with the flexibility of transferring data using Layer 2 protocols. As a result, Layer 3 switches are much faster than routers that use store and forward methods of data transfer and also have to perform several additional functions. This lesson discusses routing operations and functions and their relationship to Layer 3 switching.

What You Will Learn

After completing this lesson, you will be able to do the following:

- Describe basic routing technology
- Explain the difference between dynamic and static routing
- Explain how Layer 3 switches function
- Compare and contrast Layer 2 and Layer 3 switches



Student Notes:

Tech Talk



- **Datagram**—A packet of data at the network layer.
- **Dynamic Routing**—Entries in the routing table are not configured manually by the network administrator, the router builds the table dynamically.
- **Frame**—A packet of data at the data link layer.
- **Hop**—A jump that a datagram takes from one router to the next.
- Packet—A package of data transmitted over a communications link.
- **Routing Table**—A table that tells a router the next step a packet should take toward its destination.
- **Static Routing**—An entry in a routing table manually entered by a network administrator.
- **Time to Live**—The amount of time in seconds that a packet is allowed to try to reach its destination before being dropped.

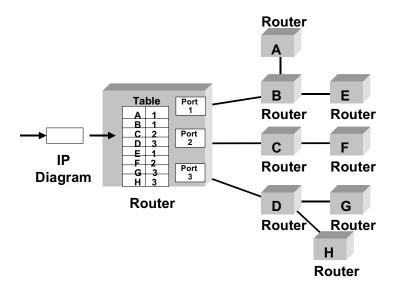


Routing Technology

Routers are capable of routing data from LANs to WANs meaning that different types of networks can be connected regardless of protocols or interfaces. When routers were first employed in networks, speed was not an issue. With the advent of the Internet, came the demand for speed in WAN environments. Initially the increased demand for speed was fulfilled by the addition of processing speed and various algorithms. However, these methods do not achieve wire-speed transmission of data across networks.

Router features include the ability to build and maintain routing tables, resolve Layer 2/3 addresses, perform time-to-live calculations, filter, translate, encapsulate, prioritize, and authenticate packets, perform checksum calculations, and more. The drawbacks of routers include the time it takes to perform these tasks, the difficulty of configuring these features, and their cost. Routers are still very expensive when compared to switches. Because of these drawbacks and the high latency inherent in the routers' store and forward method of data transmission, Layer 3 switches are preferable to routers in certain situations.

Network Routing Tables are Maintained by Routers

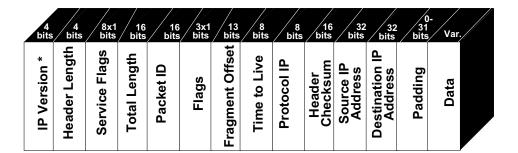


IP Router Basics

Routers discover routes, determine which is the best choice, and store that information in a routing table. They accomplish this by listening and accepting frames that are broadcast or addressed to the router. Using IP protocols, routers determine the destination address of the data. They then look up that address in their routing table to determine the port connection. Next the router forwards the data to that port or the default route if it can't find the destination address. If the port is not found and there is no defined default route, the packet is dropped.

Routers forward packets as either connection-oriented IP or connectionless UDP datagrams. These datagrams contain port numbers that identify specific ports on the destination device.

IP Datagram



Data can travel through several different routers on its way to the destination device. Routers do not need to know where the final destination address for the data is located, they need only know where the next hop is that will bring the data closer to the final destination

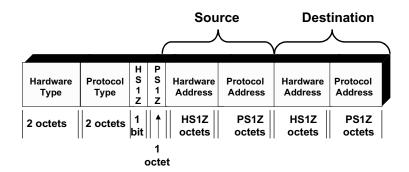
Determining Routes

Routes can be determined either statically or dynamically. Network Managers configure static routes to control the path data follows by defining a default route. Static routes increase both security and efficiency in networks by controlling the path data takes into and out of a network and reducing the number of calculations needed to move the data forward. One reason for manually configuring route paths is to ensure that data uses the fastest connection available from one network to another, even if it does involve more hops.



Dynamic routing tables are not built by network managers, they are built by routers using routing protocols such as ARP, RIP, and OSPF. These protocols allow routers to communicate with other routers in order to determine the best available routes. Dynamic routers discover routes, calculate the best route, monitor the network for changes and/or failures, and share routing information with other routers.

ARP Packet for IP Over Ethernet



Routers are store and forward devices. They receive a packet, perform their route calculations, address resolution, special services such as filtering, and then forward the packet. These relatively time-consuming procedures occur with every packet of the data transmission, which causes networks to degrade (slow down), thus causing congestion/bottlenecks. In addition, many of the routing functions are software driven rather than hardwired. More technical expertise is needed to manage routers, and the more functions a network manager configures on a router, the longer it takes to process data.

Since most traffic until recently was local, routers didn't create a problem. With the increased use of the Internet has come significantly more WAN traffic. WAN traffic was very slow when compared to LAN speeds. User demand increased for LAN speed over WAN connections. The result of this demand is Layer 3 switches and ATM and Ethernet gigabit high speed switching technology.

Check Yourself

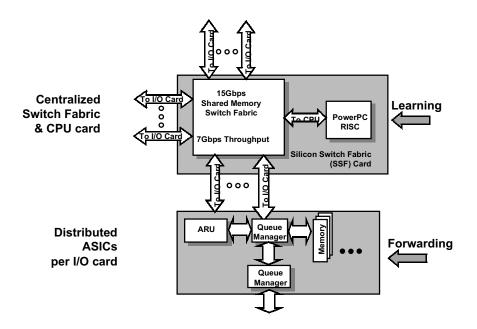
- What are some of the features that routers provide to a network?
- What are some of the drawbacks to routers?
- ♦ How do routers determine the best route(s) for data transmissions?
- What are some of the benefits of static routing?
- ♦ How do routers slow down networks?



Layer 3 Switching Technology

Layer 3 switches have all of the capabilities of Layer 2 switches, plus they can perform several routing functions and transfer data across LANs and WANs at near wire speed. This makes them an attractive alternative to more expensive, slower routers. Some of the technology that these switches employ includes IP routing protocols such as RIP and OSPF. Layer 3 switches route data between different network segments by limiting the number of routing protocols and applying as much of the technology as possible to ASIC chips rather than software or RISC chips.

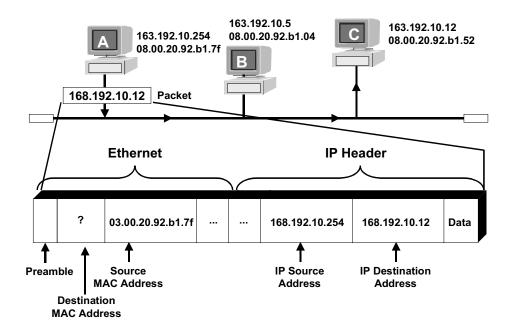
Layer 3 Switch Fabric



Layer 3 switches are built for both frame and cell switching and differ from Layer 2 switches. Although Layer 2 switches can segment broadcast domains, they cannot route data to different networks. When a data packet needs to be routed, it must utilize Layer 3 routing protocols. One method used for routing when a Layer 3 switch receives a data packet is that it sends the first data packet to a router or route server where a determination is made as to whether routing or switching the remaining stream of data is better. If it is determined that routing is the better choice, the remaining data packets of the transmission are sent through the router. However, if it is determined that switching offers more speed, then the remaining data packets are processed through the Layer 3 switch. This is achieved through the following series of steps:

- Data packets are transmitted to the switching device, across various media, using Layer 1 protocols.
- The switch then looks at the Layer 2 MAC address of the destination device to determine if it is a member of the LAN.
- If the MAC address is part of the network, it forwards the data using Layer 2 protocols and switching techniques.
- If the MAC address is not part of the network, it must be forwarded using Layer 3 protocols, such as IP or IPX.
- A Layer 3 switch sends the first packet of the data stream to a routing device where routing functions such are ARP and OSPF take place.
- The Layer 3 IP address and the MAC address of the destination device are then resolved and the best routes are discovered.
- When the Layer 3 protocols have been implemented, the IP packet is encapsulated in the frame.

IP Header Encapsulated in Data Frame



• The end systems then determine if it is faster to continue through the router using Layer 3 protocols, or to have the data switched using Layer 2 protocols.



- If it is determined that routing is faster, the remaining frames are routed.
- If it is determined that switching is faster, the new frame is then passed back to the switch, which now knows from the router how to get to the destination network segment and what the best routes are to that network.
- The remaining packets can then be switched through switching fabric at near wire speeds using Layer 2 protocols.

Two methods of Layer 3 switching are flow control and packet-by-packet. The main difference between the two is what happens with the data as it is switched from device to device on the way to its final destination. With packet-by-packet switching, each packet is examined at Layer 3 and switched using Layer 3 addresses. Flow control switching examines only the first packet at layer 3 and switches the data using only Layer 2, based on its Layer 3 destination device address. The remaining packets do not need to be examined individually at Layer 3.

Check Your Understanding

- How is data routed in an IP network using Layer 3 switches?
- ◆ In this unit you read about the differences between Layer 2 and Layer 3 switches. What is the fundamental difference between them?
- What are some of the benefits of layer 3 switching over routing?
- What are some of the benefits of Layer 2 switching.



Try It Out

Materials Needed:

• Request for Proposal



Network RFP Requirements

In this activity, you will be introduced to a document which contains a set of requirements for a real business network. It is the type of requirements document that schools, businesses, and governmental organizations use to buy network design services and network hardware and software from their suppliers. This kind of document is called a Request for Proposals (RFP) because it spells out the things the buyer is looking for and asks potential suppliers to respond with their technical and cost proposals.

In this course, you will be working with a small group of other students to prepare a comprehensive Proposal, which responds to and meets the requirements of the RFP. That Proposal will be your project for the remainder of Unit 2 and the duration of Unit 3. It will have many parts to it, and you will be working on your RFP almost every week.

In this lesson, you will read and study the RFP and take notes on its key requirements, deadlines, and deliverables. Deliverables are the things you need to research, write or draw, and deliver as part of your Proposal.

Part 1: Read and Summarize RFP

Follow these steps to read the Network RFP and summarize all of the requirements, which must be met in the proposed network. The RFP is located at the end of this activity. List the requirements in the same categories as they appear in the Statement of Work. Place your summary on the Requirements Worksheet.

- 1. Read in detail the Deliverables section of the RFP. Try to understand why each of the documents and other deliverables is important to the organization that issued the RFP. Write down any questions you have.
- 2. From the Statement of Work (SOW), fill in your RFP worksheets listing each of the important requirements in the RFP. Clues to finding requirements in the SOW are sections that say "Proposer must" or "Proposer will."
- 3. When you have completed your Requirements Summary Worksheets, share them with your team.

Part 2 - Identifying Deliverables

Follow these steps to identify the individual deliverables for this RFP and to describe each briefly. As you check off each deliverable, you should enter a date for it. Place your list on the Deliverable Worksheet.

- 1. From the Deliverables section of the RFP, fill in your worksheets listing each of the required deliverables. For each deliverable you list, make sure you understand and have identified exactly what the deliverable is, and the date it is due.
- 2. When you have completed your Deliverables Worksheets, share and compare them with the rest of your team.

Part 3 – Identify Pre-Proposal Activities

Follow these steps to identify any pre-proposal activities or submissions, which you will be required to make. Put your findings on the Pre-Proposal Activity Worksheet.

- 1. Read in detail the Pre-Proposal Activity section of the RFP. Try to understand why each of the pre-proposal activities is important to the organization that issued the RFP. Write down any questions you have.
- 2. From the Pre-Proposal Activity section of the RFP, fill in your worksheets listing each of the activities, models, simulations, and demonstrations in the RFP that must be accomplished before the proposals are due.
- 3. When you have completed your Pre-Proposal Activity Worksheets, share and compare them with your team.

Part 4 - Questions on the RFP

When an organization issues an RFP they usually set up a procedure so that questions can be answered and misunderstandings avoided. Make a list of questions you have, or things you do not quite understand about the RFP. Put the questions on the RFP Q&A Worksheet.



You have browsed through the entire Network RFP to get an idea of its contents. You have identified the following major sections: Statement of Work, Deliverables, Schedule, Pre-Proposal Activities. You have summarized and read these sections and written down your questions

Now, go back to the document and scan it again to make sure you understand all of the details. Write down any other questions you can think of.

Put your questions on the RFP Q&A Worksheet. Your teacher will hold a "Bidder's Conference" to answer your questions.

RFP

The State of Oregon

Acting by and Through the State Board of Higher Education on Behalf of

UNIVERSITY OF OREGON

REQUEST FOR PROPOSAL

RFP # 99-23456

Millennium Wide Area Network Project

Proposals Due Not Later Than:

Sections I through IV: Proposal Specifications

This is a condensation of an actual proposal from the State of Oregon. Several pages of format and specifications accompanied the RFP. Since they are not necessary for this project, only four samples are included. You can search the Internet to obtain the complete proposal if you want to see all of the legalities involved.

- 1. Proposals shall be prepared by typewriter, word processor, or legibly handwritten/printed in ink, and shall be signed by an authorized representative of the proposer. Alterations or erasures shall be initialed in ink by the person signing the Proposal Statement. No oral, telegraphic, or telephone proposals will be accepted. Facsimile or Electronic Data Interchange (EDI) proposals will be accepted only if such acceptance is specifically set forth in this RFP.
- 2. Proposers shall submit two (2) sealed copies of their proposal, following the Institution's outline, <u>and</u> this Request for Proposal, with the Proposal Statement completed and signed.
- 3. All envelopes in which the RFP/Proposal Statement and your proposal are submitted MUST be clearly marked PROPOSAL, noting the RFP number, and date and time of closing.

The remaining portions of the RFP, up to Section 5, have been omitted. These sections discuss the criteria to be followed by the Proposer. For example, the length, due date, appearance, general information, and other requirements that must be met in order to receive the award.

Award Notice.

Upon approval of the Institutional evaluation committee's recommendation, a contract will be drawn which will include by reference this RFP, the proposer's proposal, and any additional contractual language as may be required by Institution or by law. Prior to contract award, the apparent successful proposer will be notified in writing of its apparent winning proposal. All other proposers will be notified in writing that the apparent winning proposal has been selected.

Several sections have been omitted once again.

Section V: Proposal Statement

The individual signing this Proposal Statement warrants they have authority to bind the Proposer by their signature.

Signature:	Dated:	_
Name:	Grade:	
Class:		
Address:		
City/State/Zip:	Phone:()	

EXHIBIT A: Network Requirements

The requirements for the network include the following:

1. Shared access to the Internet from a State Approved Tier 1 Internet Backbone ISP at a predetermined location that is 43 miles from the main campus. The shared access to the Internet will support at least 40 Mbps of data traffic.



2. Dedicated connection of the following six buildings, and off-campus dial-up connections to the Millennium Network Control Center:

Building	LAN	Km to Center	User Ports	Link
Adams Hall	10baseT	7.6	230	T1
Jefferson Hall	100baseT	12.4	89	4 - T1
Lincoln Hall	10baseT	1.3	123	T1
Reagan Hall	1000baseT	5.0	498	12 – T1
VanBuren Hall	100baseT	2.8	205	2 - T1
Washington Hall	10baseT	14.6	37	2 - ISDN
Off Campus Users	Dial-Up	-	48 port	56K

3. Design of a hierarchical hub and switch topology at each of the buildings using the following guidelines:

Users	Routers	Switches	Hubs
1 per network port	1 per building link	1 per 8 hubs	12 port
1 Nic card	1 LAN cable	Switch to hub cables	Hub to port cables
Port to computer nic cables	Live backup router	Distance to router – 5 meters	Hub to switch cables – 50 meters

The network should be designed with 25% extra capacity. The number of switches and hubs should be based on the actual number of users plus 25% additional for growth and to cover labs.

4. Design, specification, and equipment for Millennium Network Management Center. This equipment and software will be specified to enable the central network staff to diagnose, maintain, and support the campus wide network.

EXHIBIT B: Summary of Network RFP Requirements

Proposers will review this RFP in its entirety and will provide the following documentation by _____:

- Read and summarize the requirements in the RFP Statement of Work. In your summary, list each of the specific network requirements separately.
- Make a complete checklist of the individual deliverables for this RFP and describe each briefly.
- Associate a date with each deliverable identified in the prior step.

Identify any pre-proposal activities or submissions you will be required to make.

• Make a list of questions you have, or things you do not understand about the RFP.

EXHIBIT C: Packet Modeling Report

In order to validate the design assumptions, proposers will model traffic on a 10BaseT network and will include the results of the modeling with their proposal.

Utilization and Collision Data will be provided in the following table to report on tests where two stations generated traffic simultaneously:

Scenario	Packet Size	Delay	Utilization %	Collisions %
Α	64	64		
В	128	64		
С	256	128		
D	1024	256		

Each proposer will interpret these results in a written paragraph and will describe ways to reduce or eliminate congestion in a LAN.

Data and Traffic Models will be graphed in the following format:

Graph Packet Size on the X axis and Delay on the Y axis to show Utilization in BLUE and Collision in RED

EXHIBIT D: Network Management Center Plan

Proposers will satisfy the following requirements for the Millennium Network Control Center. The Control Center's role is to assure nonstop operation of the campus network and to provide the following services:

- 1. Network File Server Compaq 7000 or equivalent 1 GB RAM with 750 Gbp of RAID Storage
- 2. Network Web Server Compaq 3000 or equivalent 512 MB RAM 50 Gbp Storage
- 3. Network Mail Server Compaq 3000 or equivalent 512 MB RAM 50 Gbp Storage
- 4. Network Firewall and Proxy Server Compaq 3000 or equivalent 512 MB RAM 50 Gbp Storage
- 5. Network Management Control Server Compaq 1850 or equivalent 256 MB RAM 36 Gbp Storage
- 6. Racks, cables, and miscellaneous equipment
- 7. Network management tools and software
- 8. Network operating systems licenses



EXHIBIT E: Proposed Network Price Report

The pricing for the network should be based on the requirements contained in Exhibit A and shall include the following:

- 1. Cost of Link for shared access to the Internet from a State Approved Tier 1 Internet Backbone ISP from the main campus to at a predetermined location that is 43 miles from the main campus. The shared access to the Internet will support at least 40Mbps of data traffic. One time charges, recurring monthly telecommunications charges, and Internet access charges shall be included.
- 2. Dedicated connection of the following six buildings, and off-campus dial-up connections to the Millennium Network Control Center:

Building	LAN	Km to Center	User Ports	Link
a. Adams Hall	10baseT	7.6	230	T1
b. Jefferson Hall	100baseT	12.4	89	4 - T1
c. Lincoln Hall	10baseT	1.3	123	T1
d. Reagan Hall	1000baseT	5.0	498	12 – T1
e. VanBuren Hall	100baseT	2.8	205	2 - T1
f. Washington Hall	10baseT	14.6	37	2 - ISDN
e. Off Campus Users	Dial-Up	-	48 port	56K

Pricing for telecommunications connectivity shall include one time charges and recurring monthly telecommunications charges for each link and the dial-up lines.

3. Design of a hierarchical hub and switch topology at each of the buildings using the following guidelines:

Users	Routers	Switches	Hubs
1 per network port	1 per building link	1 per 8 hubs	12 port
1 Nic card + cable	1 LAN cable	Switch to hub cables	Hub to port cables
Distance to hub –	Live backup router	Distance to router – 5	Distance to switch –
20 meters		meters	50 meters

The network should be designed with 25% extra capacity. The number of switches and hubs should be based on the actual number of users plus 25% additional for growth and to cover labs.

Pricing for hardware and infrastructure shall include cabling costs, cost of port blocks, LAN cables, patch panels, hubs, switches, routers, NIC cards, and backup equipment.

4. Design, specification, and equipment for Millennium Network Management Center. This equipment and software will be specified to enable the central network staff to diagnose, maintain, and support the campus wide network.

Pricing for the Network Control Center shall include hardware, software, cables, racks, and servers.

Rubric: Suggested Evaluation Criteria and Weightings:

Criteria	%	Your Score
RFP Q&A Worksheet. Questions	20	
Accurate date associated with each deliverable	10	
Checklist and brief description of each deliverable	20	
Identification of pre-proposal required activities or submissions	20	
List of questions or points not understood	20	
Worked as a member of a team in a professional manner. Workspace cleared when activity is complete	10	
Other		
TOTAL	100	



Stretch Yourself

Materials Needed:

- Internet connection
- Research materials for network switches
- Spreadsheet software
- Calculator (optional)

Comparing Switches

- 1. Using the Internet, research <u>www.nortelnetworks.com</u> for the features of several switches. Research three additional companies that sell switches. Work in groups of four. Each individual is responsible for one company.
- 2. Write a short description of the companies and list their switching products and prices. Compare the prices and features.
- 3. Each member of the group should prepare a two-page description of both a Layer 2 and a Layer 3 switch from the company you are researching. Describe the similarities and differences you found. Does the company use proprietary protocols, standard protocols, or both? Would you always choose the same company? Why or why not? Why would you choose to purchase a Layer 2 switch? Give examples of when you would want to spend the extra money for a Layer 3 switch. Include any other information you feel pertinent. List your web site resources including the URL for each site.
- 4. As a group create one table or spreadsheet to accompany your descriptions. The spreadsheet should calculate and/or display the average cost of each switch type for the companies you have researched. Calculate the cost of each port.
- 5. Present your findings to the class in an informal setting. Discuss the similarities and differences found within the specified deadline. Add documents to your portfolio.



Rubric: Suggested Evaluation Criteria and Weightings:

Criteria	%	Your Score
Documentation included in portfolio	10	
Thorough analysis of the products/features	25	
Spreadsheet organization, layout, format, `etc.	20	
Active participation in classroom discussion	20	
Other	25	
TOTAL	100	



ST0025805A

2-95

Network Wizards

Materials Needed:

Windows 95 PC and Windows 95 CD-ROM



The Windows 95/98 Utilities

In this activity, you will explore MS-DOS and Windows 95/98 utilities. Network administrators often use these utilities when troubleshooting networking problems. You are already with the ping, winipcfg, tracert, ftp, and telnet utilities.

Part 1: Review

Answer the following questions. If you do not know the answers, research them.

- 1. What is the ping utility used for?
- 2. What is the ftp utility used for?
- 3. What is the telnet utility used for?
- 4. What is the winipcfg utility used for?
- 5. What is the tracert utility used for?

Part 2: ARP

- 1. From the Windows 95/98 window select Start > Programs > MS-DOS.
- 2. At the MS-DOS prompt, type **ARP** and press Enter. A new window opens.
- 3. Answer the following questions.
 - ♦ What information does **ARP- a** and **ARP -g** display when entered?
 - ♦ What information does **ARP inet_addr** display when entered?
 - ♦ What information does **ARP –N if_addr** display when entered?
 - ♦ What information does **ARP -d** display when entered?
 - ♦ What information does **ARP -s** display when entered?
 - ♦ What information does **ARP eth_addr** display when entered?
 - What information does ARP if_addr display when entered?
- 4. Try out each of the ARP commands.
 - ♦ How might ARP be useful for troubleshooting IP addresses?
 - ♦ How might this utility be used to solve the problem to duplicate IP addresses?



Part 3: nbtstat

- 1. Select Start > Programs > MS-DOS.
- 2. At the MS-DOS prompt, type **nbtstat** and press Enter. A new window opens.
- 3. Answer the following questions.
 - ♦ What information does **nbtstat –a** display when entered?
 - ♦ What information does **nbtstat** -A display when entered?
 - ♦ What information does **nbtstat** -c display when entered?
 - ♦ What information does **nbtstat** –**n** display when entered?
 - ♦ What information does **nbtstat -r** display when entered?
 - ♦ What information does **nbtstat** –**R** display when entered?
 - ♦ What information does **nbtstat –S** display when entered?
 - What information does nbtstat -s display when entered?

Part 4: netstat

- 1. Select Start > Programs > MS-DOS.
- 2. At the MS-DOS prompt, type **netstat** and press Enter. A new window opens with information about active connections.
- 3. Answer the following questions.
 - ◆ Type **netstat –a**. What information is displayed?
 - ◆ Type **netstat** –**e**. What information is displayed?
 - ◆ Type **netstat -r**. What information is displayed?
 - ◆ Type **netstat -s**. What information is displayed?

Rubric: Suggested Evaluation Criteria and Weightings:

Criteria	%	Your Score
Complete, accurate answers to questions that indicates a thorough understanding of concepts	45	
Portfolio entries complete	15	
On time delivery of assignment	10	
Professional quality switch diagrams	30	
Other		
TOTAL	100	



Summary

Lesson 3: Layer 3 Switches

In this unit, you learned to do the following:

- Describe basic routing technology
- Explain the difference between dynamic and static routing
- Explain how Layer 3 switches function
- Compare and contrast Layer 2 and Layer 3 switches

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Name							

Lesson 3: Layer 3 Switches

- 1. Bridges are the fundamental technology in:
 - a. Routers.
 - b. Switches.
 - c. Both of the above.
 - d. None of the above.
- 2. Which of the sentences below best describes the difference between datagrams and frames?
 - a. A datagram is a packet of data at the data link layer, while frames are packets of data at the network layer.
 - b. A frame is a packet of data at the data link layer, while datagrams are packets of data at the network layer.
 - c. Both datagrams and frames are packets of data at the network level, but datagrams are larger.
 - d. Both datagrams and frames exist at the data link layer, but frames hold more data.
- 3. Which one of the following statements about routers is false?
 - a. When routers were first employed in networks, speed was not an issue.
 - b. Routers can build and maintain routing tables.
 - c. Routers can perform time-to-live calculations.
 - d. Routers route data from LANs to WANs, but only if the two networks are compatible.



- 4. Which of the following statements about routers is true?
 - a. Routers are slower than switches, but less expensive.
 - b. Routers are easy to configure.
 - c. Routers have the ability to build and maintain routing tables.
 - d. Routers that use ASIC technology can achieve wire-speed of technology across networks.
- 5. Which of the following statements best explains why increased processing speed and improved algorithms in routers did not satisfy the need for more speed in WAN environments?
 - a. Writing these algorithms is complicated and very expensive due to required programmer time.
 - b. The algorithms would often fail and the network would be slowed down.
 - c. These methods did not result in wire-speed transmission of data.
 - d. People wanted less expensive solutions.
- 6. Which one of the following statements about routers is false?
 - a. Routers discover routes, determine the best choice route, and store this information in a routing table.
 - b. Routers determine the destination address of the data by using IP protocols.
 - c. Routers look up the address in their routing table to determine the port.
 - d. Routers immediately drop the packets if the port is not found.
- 7. Which one of the following statements is true?
 - a. Routers forward packets as either connection-oriented IP or connectionless UDP datagrams.
 - b. Data travels to only one router on its way to the destination device.
 - c. Routers must know the final destination.
- 8. Which one of the following statements about static and dynamic routing is false?
 - a. Dynamic routes are configured by the router.
 - b. Static routes increase security by allowing the network manager to control the path data takes in and out of the network.

- c. Static routes increase efficiency by reducing the number so calculations needed to move data forward.
- d. Manually configuring route paths ensures fewer hops.
- 9. Which of the following statements about dynamic routing is true?
 - a. Dynamic routing uses routing protocols such as ARP and OSPF
 - b. Dynamic routing uses routing protocols such as ARP and RIP.
 - c. Dynamic routing uses routing protocols such as OSPF and RIP.
- 10. Which of the following best describes why layer 3 switches were developed?
 - a. Routers perform many procedures, which causes networks to degrade.
 - b. Many of the procedures are software driven, which is slower than hardware driven procedures.
 - c. With the Internet and increased traffic, routers became a problem.
 - d. All of the above.
- 11. Which of the following helped to speed up WAN networks?
 - a. ASIC chips in switches.
 - b. ATM.
 - c. Ethernet gigabit high speed switching technology.
 - d. All of the above.



- 12. Which of the following statements about Layer 3 switches is false?
 - a. Layer 3 switches have all capabilities of Layer 2 switches, plus they perform several routing functions.
 - b. Layer 3 switches transfer data across LANs and WANs at near wire speed.
 - c. Layer 3 switches have many more routing protocols than old routers, but are fast because of their use of ASIC chips.
 - d. Layer 3 switches are faster and less expensive than routers.
- 13. Which of the following statements is true?
 - a. Data packets arrive at the switching devices using Layer 3 protocols.
 - b. One Layer 3 method sends the first packet to a router or router server where it determines whether routing or switching is better.
 - c. If switching is better all packets are then sent to the Layer 3 switch.
- 14. Which of the following statements is false?
 - a. Data packets arrive at the switching devices using Layer 2 protocols.
 - b. If the MAC address is part of the network, it forwards the data using Layer 2 protocols.
 - c. If the MAC address is not part of the network, it forwards the data using Layer 3 protocols.

- 15. Which statement below best describes the difference between flow control and packet-by-packet methods of Layer 3 switching?
 - a. Packet-to-packet uses Layer 3. Flow control uses Layer 3 and Layer 2.
 - b. Flow control switching examines the first packet at Layer 3 and switches the data using Layer 2, based on the Layer 3 destination device address. Packet-to-packet examines each packet at Layer 3 and uses Layer 3 addresses and switches to move the data.
 - c. Flow control uses Layer 3 to examine and move all packets. Packet-to-packet uses Layer 3 to examine all packets, but uses Layer 2 to move all packets.



Scoring

Criteria	Points	Your Score
Check Your Understanding		
Describe basic routing technology	25	
Explain the difference between dynamic and static routing	25	
Explain how layer 3 switches function		
Compare and contrast layer 2 and layer 3 switches	50	
Other	100	
Try It Out: Subtitle	100	
Stretch Yourself: Subtitle	100	
Network Wizards: Subtitle	100	
Lesson Review	100	
TOTAL	500	

Resources

Metzler, Jim, DeNoia, Lynn (1999). Layer 3 Switching: A Guide for IT Professionals, Prentice Hall. PTR, Upper Saddle River, New Jersey.

Minoli, Daniel, Schmidt, Andrew (1998). Network Layer Switched Services. John Wiley & Sons, Inc., Net York, New York.

Black, Darryl P. (1999). Building Switched Networks: Multilayer Switching, QoS, IP Multicast, Network Policy, and Service Level Agreements., Addison-Wesley, Reading, Massachusetts.

