There are two parts to this assignment. Please make sure to complete all parts.

**Part 1: Backbone Networks**

Review the diagram of the backbone network below, and then answer the series of questions.



1. The textbook explains the three layers that exist in a backbone network. The diagram above has several labeled computers, switches, and routers that are part of these layers. For all labeled devices, identify their layer, and explain the function the device plays in this backbone network.

Router A: core layer, get message from router B, check the address about the message

and sends it to right LAN.

Router B: core layer, get message from router C, check the address whether it will be sent to building 1.

Router C: core layer, get message from router B, check the address whether it will be sent to building 2.

Router D: core layer, get message from router C, check the address about the message

and sends it to right LAN.

Router 1/2/3/4: distribution layer, get message from router A/D, check the address.

Switch 1/2/3/4: access layer, send message to the right address, exchange message from computer to computer.

Computer 1/2/3/4: accept message, display the message, send message.

Each router and switch can accept message from the access layer and check the address.

2. The textbook describes three types of backbone networks – switched, routed, and a mixture of the two. What type of backbone network does this diagram illustrate? Explain your answer.

This diagram is a routed backbone because it has routers at the core layer and distribution layers and switches at the access layer.

3. Imagine that Computer 1 broadcasts a data-link layer frame.

1. Would other computers or devices on LAN 1 receive this broadcast? Explain your answer.

Other computers will receive this broadcast as switch broadcasts frame to all the ports as for switch there is a single broadcast domain.

1. Would this broadcast be restricted only to a single LAN, or to multiple LANs? Explain your reasoning.

It will just broadcast in LAN1. Because it needs other LAN’s broadcast address, but this data link layer works on the MAC address, so it isn’t possible for this frame to broadcast outside the LAN1.

4. Imagine that Computer 1 generates an IPv4 packet that is destined for Computer 3. Assume that Computer 1 knows the IPv4 address of Computer 3, and also assume that the forwarding and routing tables of all switches and routers respectively are fully populated to ensure readily available end-to-end communication between any two devices. Explain step-by-step how that IPv4 packet will travel the network to arrive at its destination. In your answer, make sure to identify the source and destination MAC and IPv4 addresses by labeling them with the attached device name, for example, “Computer 3’s MAC address” or “Computer 3’s IP address”.

1. Add source IP address (Computer 1’s IP address), destination IP address (Computer 3’s IP address), source MAC address (Computer 1’s MAC address) and destination MAC address (Router 1’s MAC address)
2. Then the packet will be sent to Router 1. The destination MAC address will be changed to Router A’s MAC address
3. Then the packet will be sent to Router A. The destination MAC address will be changed to Router B’s MAC address.
4. Then the packet will be sent to Router B. the destination MAC address will be changed to Router C’s MAC address.
5. Then the packet will be sent to Router C. the destination MAC address will be changed to Router D’s MAC address.
6. Then the packet will be sent to Router D. the destination MAC address will be changed to Router 3’s MAC address.
7. Then the packet will be sent to Router 3. the destination MAC address will be changed to Computer 3’s MAC address.
8. Then the packet will be sent to Computer 3.

5. Imagine that all of the routers except for Router B and Router C are replaced with switches.

1. What would the new backbone architecture be (switched, routed, or hybrid)? Explain.

Switched backbone, commonly each LAN will have its own switch, and that switch will connect into a central switch

1. If Computer 1 broadcasts a data-link layer frame with this new architecture, which LANs and devices would receive this broadcast?

LAN1 and LAN2, they are connected with switch and will come under one network both LAN can receive the broadcast message.

1. Suppose that a total of few hundred employees work in Building 1 and Building 2 with many more LANs than what is illustrated in the diagram. What would be the advantages and disadvantages of this new architecture as compared to the old?

**Advantages**

* Performance is improved. With the traditional backbone network, the backbone circuit was shared among many LANs; each had to take turns sending messages. With the collapsed backbone, each connection into the switch is a separate point-to-point circuit. The switch enables simultaneous access, so that several LANs can send messages to other LANs at the same time. Throughput is increased significantly, often by 200% to 600%, depending upon the number of attached LANs and the traffic pattern.
* Since there are far fewer networking devices in the network, this reduces costs and greatly simplifies network management. All the key backbone devices are in the same physical location, and all traffic must flow through the switch. If something goes wrong or if new cabling is needed, it can all be done in one place.
* Software reconfiguration replaces hardware reconfiguration.

**Disadvantages**

* Because data link layer addresses are used to move packets, there is more broadcast traffic flowing through the network and it is harder to isolate and separately manage the individually attached LANs. Layer 3 switches can use the network layer address, so future collapsed backbones built with layer 3 will not suffer from this problem.
* Collapsed backbones use more cable, and the cable must be run longer distances, which often means that fiber optic cables must be used.
* If the switch fails, so does the entire backbone network. If the reliability of the switch has the same reliability as the reliability of the routers, then there is less chance of an failure (because there are fewer devices to fail).

**Part 2: Wide Area Networks (WANs)**

Review the architectural diagram of the WAN below, which illustrates a single organization’s WAN links between its campuses across the United States.



6. The textbook describes four types of WAN configurations – ring, star, partial mesh, and full mesh. Which configuration is illustrated in the diagram above? Explain your answer.

Full mesh, there is a connecting between each city. Ring architecture connect each city in a circle (Portland-LA-SA-Miami-NYC-KC). Star architecture connect one city to each other (KC-Portland, KC-LA, KC-SA, KC-Miami, KC-NYC). Partial Mesh connect part of city each other (Portland-KC, KC-NYC, NYC-Miami, Miami-SA, SA-LA, LA- Portland, SA-KC, Miami-KC).

7. Imagine that network traffic is coming from Portland and traveling to Miami. The most obvious route the traffic can take is Portland to Miami, due to the direct connection between the two campuses. Assuming all WAN links are operational, identify a two-hop route, a three-hop route, a four-hop route, and a five-hope route between Portland and Miami.

Two-hop: Portland – Kansas City – Miami

Three-hop: Portland – Los Angeles – San Antonio – Miami

Four-hop: Portland – Los Angeles – San Antonio – Kansas City – Miami

Five-hop: Portland – Los Angeles – San Antonio – Kansas City – New York City – Miami

8. Now imagine that both Kansas City and San Antonio are entirely offline. How many operational routes would there be from Portland to Miami? Identify each route along with its number of hops.

* Route 1: Portland – Miami (1 hop)
* Route 2: Portland – New York City – Miami (2 hops)
* Route 3: Portland – Los Angeles – Miami (2 hops)
* Route 4: Portland – New York City – Los Angeles – Miami (3 hops)
* Route 5: Portland – Los Angeles – New York City – Miami (3 hops)

9. Imagine that the organization needs to remove four WAN links to save on cost (and that all links are operational again). Identify four links to be removed. You should ensure that, between any two campuses, the new configuration has *at least one route* that contains no more than two hops. It is fine if other routes are more than two routes, but there should be at least one route that is no more than two hops between any two campuses.

Remove:

* Route 1: Portland – New York City
* Route 2: Los Angeles – Miami
* Route 3: Portland – Miami
* Route 4: Los Angeles – New York City

10. With the four WAN links removed, what is the new WAN configuration, ring, star, partial mesh, or full mesh? What are the advantages of the new configuration over the old? Explain your answer.

Partial Mesh

Advantages:

* It usually provides relatively short routes through the network.
* Also provides many possible routes through the network to prevent any one circuit or computer from becoming overloaded when there is a lot of traffic.
* It saves a lot of money.
* Easy to manage

Disadvantages:

* Every node is not connected physically to every other node, each router has not connected to every other router.
* Bad redundancy than full mesh

Your assignment will be evaluated according to the following rubric.

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|  | **Grade** | **Qualities Demonstrated by the Assignment Submission** | **Grade Assigned** |
| **Content (70%)**  **Measures the quality of the content in the assignment** | A+ 🡺 100 | The content demonstrates exceptional understanding of all relevant subject matter and its inter-relationships. All major relevant issues are thoroughly covered, and all content is very focused and on-topic. There is no known way to improve the content, and there are absolutely no technical or coverage errors present. |  |
| A 🡺 96 | The content demonstrates exceptional understanding of all relevant subject matter and its inter-relationships. All major relevant issues are thoroughly covered, and all content is very focused and on-topic. At most one insignificant technical or coverage error may be present |
| A- 🡺 92 | The content demonstrates deep understanding of all relevant subject matter and its inter-relationships. All major relevant issues are covered, and all content is on-topic. |
| B+ 🡺 88 | The content demonstrates understanding of all relevant subject matter and its inter-relationships. Almost all major relevant issues are covered, and the content is at least reasonably on-topic. |
| B 🡺 85 | The content demonstrates understanding of most relevant subject matter and its inter-relationships. Almost all major relevant issues are covered, and all content is at least reasonably on-topic. |
| B- 🡺 82 | The content demonstrates moderate understanding of much relevant subject matter and its inter-relationships. There is reasonable coverage of major relevant issues, and the content is at least reasonably on-topic. |
| C+ 🡺 78 | The content demonstrates some understanding of relevant subject matter and its inter-relationships. Some major relevant issues are covered, and at least some content is on-topic. |
| C 🡺 75 | The content demonstrates understanding of a small portion of the relevant subject matter and its inter-relationships. Some major relevant issues are covered, and at least a small portion of the content is on-topic. |
| C- 🡺 72 | The content demonstrates little understanding of and insight into the relevant subject matter and its inter-relationships. A small portion of the major relevant issues are covered. The focus of the content may be off topic or on insubstantial or secondary topics |
| D 🡺 67 | The content demonstrates almost no understanding of or insight into the relevant subject matter and its inter-relationships. Almost none of the major relevant issues are covered, and the content may be almost entirely off-topic. |
| F 🡺 0 | The content demonstrates no understanding of or insight into the relevant subject matter and its inter-relationships. No major relevant issues are covered, and the content is entirely off-topic. |
| **Exposition (30%)**  **Measures how well the content is expressed** | A+ 🡺 100 | The presentation of all ideas and designs is exceptionally clear and persuasive; the entire submission is exceptionally organized. There is no known way to improve the clarity or organization of the submission. |  |
| A 🡺 96 | The presentation of all ideas and designs is exceptionally clear and persuasive; the entire submission is exceptionally organized. There may be at most one insignificant way to improve the clarity or organization of the submission. |
| A- 🡺 92 | The presentation of all ideas and designs is very clear and persuasive; the entire submission is very organized. |
| B+ 🡺 88 | The presentation of all ideas and designs is clear and persuasive; the entire submission is organized. |
| B 🡺 85 | The presentation of most ideas and designs is clear and persuasive; most of the submission is organized. |
| B- 🡺 82 | The presentation of most ideas and designs is generally clear; most of the submission is reasonably organized. |
| C+ 🡺 78 | Some parts of the submission are hard to understand; some parts are disorganized. |
| C 🡺 75 | About half of the submission is hard to understand; about half is disorganized. |
| C- 🡺 72 | Most parts of the submission are hard to understand; most parts are disorganized. |
| D 🡺 67 | Almost all of the submission is hard to understand and disorganized. |
| F 🡺 0 | The entire submission is hard to understand and disorganized. |
| **Overall Assignment Grade:** | | | |

Use the **Ask your Facilitator Discussion Board** if you have any questions regarding how to approach this assignment.

Save your assignment as ***lastnameFirstname\_assignment4.doc*** and submit it in the *Assignments* section of the course.

For help uploading files please refer to the *Technical Support* page in the syllabus.