COLLABORATION EXERCISE 3 – Southeastern State University Computing Sciences Building Addition: Design & Cost Assessment

**Scenario:** Southeastern State University (SSU) has received funding from the state Legislature to add a wing to Computing Sciences Building (which includes classrooms, labs, and faculty offices for the departments of Computer Science, Computer Engineering, and Business Information Systems). A preliminary floor plan for the first floor of the new wing is illustrated in Exhibit 1.



**Exhibit 1** Layout of First Floor of CS Building

The SSU campus has a core-layer fiber optic backbone network interconnecting its buildings. The Computing Sciences Building will connect to the campus backbone via the router in the server room (illustrated in Exhibit 1).

**Assignment Overview**

In this collaboration assignment, your group will:

1. Create logical network diagrams for the building backbone network, server room network, and wireless overlay network that will be deployed in the new wing.
2. Identify appropriate price/cost information from Figure 8-16 in the textbook for specified cost estimates for the wired Ethernet network infrastructure (switches and cabling) for the new wing for the Computing Sciences Building.
3. Use Figure 8-16 in the textbook to develop cost estimates for the WiFi overlay network infrastructure (access points, cabling, and PoE switch) that will be installed in the new wing.
4. Identify education institution costs for system and application software that will be used in the specified labs, classrooms, and offices of the building addition.

IMPORTANT INFORMATION ABOUT CLASSROOMS, LABS, OFFICE AREA, SERVER ROOM, and WiFi LAN.

Each classroom and lab depicted in Exhibit 1 will be equipped with:

* An instructor’s console/workstation (similar to that in CEIT 2205 at GSU).
* A Crestron projection and classroom lighting control system.
* A high-speed network printer.
* Riser (raised) floors
* Sufficient computer and electrical interfaces needed to handle the maximum number of students planned for each room.
* PCs with 100/1000/10000 Ethernet cards.

*Note:* The instructor’s console/workstation and Crestron projection/lighting system for each classroom and lab have been purchased; so have the PCs for Labs A, B and C. These are not included in the cost estimates for this assignment.

*LABS*

Except for Lab A, each student PC and instructor workstation will be connected by Cat 6 UTP to the switch which supports the classroom/lab.

Lab A will be a computer engineering lab equipped with high-end large-monitor workstations. Each workstation in this lab and the instructor’s workstation/console will be connected by multimode fiber to the switch(es) that support the lab.

Lab B will be a networking lab (similar to CEIT 2208 at GSU). It will be equipped with:

* Server/switch racks, switches, and routers that students will used to create networks; these have been purchased.
* A router to enable any network created in the lab to access the Internet (via the router in the server room). This has been purchased and is not part of the cost estimates for this assignment.

Lab C will be a general-purpose lab (a small lab similar to Eagle Lab A in the IT Building at GSU). The machines in this lab will connect to the switch that supports this lab with Cat 6 UTP.

*CLASSROOMS*

Each classroom will be equipped with laptop computer tables similar to those found in CEIT 2205 at Georgia Southern University.

An Ethernet port and power source will be located at each student seat in the classroom to enable each student to connect to the network via an Ethernet cable if he/she is so inclined.

Each classroom will accommodate 32 students at tables similar to those shown via the following link.

<http://www.connectworld.net/cgi-bin/computer_desk/GLTT36>

*OFFICE AREA*

Faculty offices will be also be located on the first floor of the new wing of the Computing Sciences Building. These are illustrated in the lower third of Exhibit 1.

General Information about the Office Area:

* All PCs in the office area are equipped with 100/1000/10000 Ethernet cards.
* Each office in the office area has two electrical receptacles and two RJ-45 wall jacks
* The Lab Assistants room will include two computers and a network printer.
* The Reception area will include a PC and a network printer
* The office area will be supported by a dedicated Ethernet switch.
* Each PC will connect to the switch via Cat 6 UTP.

*SERVER ROOM*

The server room will include racks (already purchased) that will house the access switches that serve the classrooms, labs, office area, and wireless overlay network. The racks will also house:

* Two application (file) servers; one supports the classrooms and labs, the other supports the office area
* A database server
* Storage server
* Storage area network
* An uninterruptible power supply system.
* The building backbone distribution switch

Each access-layer switch that serves a classroom, lab, or office area, connects to the backbone distribution switch using Fiber 1GbE patch cable.

Fiber 1GbE patch cable will connect the backbone distribution switch to the router that interfaces with the campus network.

*WIRELESS OVERLAY LAN*

The administration of Southeastern State University has determined that the new building wing will also support wireless access to the Internet. Current plans call for this to be a IEEE 802.11ac wireless overlay network that includes eight Power over Ethernet (PoE) access points that will connect to a Power over Ethernet (PoE) switch using STP Cat 5e cable.

DIAGRAM OF BUILDING BACKBONE NETWORK

Task 1: Your first task is to create a logical diagram of the building backbone network that will be installed in the new wing of the Computing Sciences Building at SSU.

*Note:* this will be similar to the logical network diagrams created for the buildings in Collaboration Exercise 2 (and the diagram of the backbone network created in the Chapter 8 Individual Assignment.)

This diagram should illustrate access switches that will serve the labs, classrooms, server room, Office Area, and wireless overlay network and the cabling that is used to connect them to the building distribution switch.

This diagram should include:

* Ten labeled access-layer switches.
  + Four that serve the Labs (two for Lab A; one each for Lab B, and Lab C)
  + Three that serve the Classrooms (one for each classroom)
  + One that serves the Office Area
  + One that serves the Server Room
  + The PoE switch to which the WiFi access points connect
* The building distribution-layer switch to which all access-layer switches connect
* The Fiber 1 GbE cables that connect the access-layer switches to the building’s distribution-layer switch
* The Fiber 1 GbE cable that connects the router (to the campus backbone) to the building distribution-layer switch
* The router that provides the gateway from the building to the campus core-layer backbone network.
* The fiber optic circuit that connects the router to the campus’s core-layer backbone network.

Ideally, the number of users served by each access-layer switch will be communicated in the logical diagram. Note: the number of ports in the switch may exceed the number of users served.

DIAGRAM OF SERVER ROOM NETWORK

*Task 2*: The second task requires the creation of a logical network diagram of the server room network.

This diagram should include:

* Two application (file) servers; one supports the classrooms and labs, the other supports the office area
* A database server
* Storage server
* Storage area network (SAN)
* The server room access-layer switch
* The building’s distribution-layer switch
* The router to the campus backbone network
* The Fiber 1 GbE cables used to connect the servers and SAN to the server room access-layer switch.
* The Fiber 1 GbE cables that connect the access-layer switch and the router to the building distribution-layer switch.

DIAGRAM OF WIRELESS OVERLAY LAN

*Task 3*: The third task requires the creation of a local network diagram of the wireless overlay network.

This diagram should include:

* Eight PoE access points
  + Three support the Labs (one per lab)
  + Three support the Classrooms (one per classroom)
  + Two support the Office Area
* The PoE switch to which the access points (APs) connect
* The STP Cat 5e cables that connect the access points to the PoE switch
* The building distribution-layer switch.
* The Fiber 1 GbE cable that connects the PoE switch to the building distribution-layer switch
* The router that provide the gateway to the campus backbone network
* The Fiber 1 GbE cable that connects the router to the building distribution-layer switch.

**HARDWARE COST ESTIMATES FOR CLASSROOMS, LABS, and OFFICE AREA**

**Task 4:** Your fourth task is to provide cost estimates for the cabling and switches for the classrooms, labs, and office area in the new wing of SSU’s Computing Sciences Building.

To complete this task you need to identify and apply appropriate equipment, cabling and prices in Figure 8-16 (page 244 of textbook) to to support each classroom, lab, and the office area.

***Note 1:*** To identify the size and/or number each required switch, you must first count the number of client devices (depicted in Exhibit 1) that need to be supported in the lab, classroom, or area; network printers and instructor consoles must be included in this count.

***Note 2:*** With the exception of Lab A, each switch used to support a classroom, lab, or the office area should be a 10/100/1000Base-T Ethernet switch that includes a fiber port upgrade to ensure that it has a 1000Base-F port that will be used to connect it to the building backbone distribution switch via a Fiber 1 GbE cable.

***Note 3:*** The access switch(es) for Lab A will be 10/100/1000Base-F with an additional fiber port upgrade to ensure that it has a 1000Base-F port that will be used to connect it to the building backbone distribution switch via a Fiber 1 GbE cable. Fiber 1 GbE cables will connect the client devices in this lab to the access switch(es).

***Note 4:*** The following tables are provided to enable you to systematically aggregate cost estimates for the hardware needed for each classroom, lab, and office area.

***Lab A***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Number of Client Devices in Lab** | **Number of Ports per Switch** | **Number of Switches** | **Price per switch** | **Total Cost** |
| 10/100/1000Base-F Ethernet Switch(es) | 1 | 48 | 2 | 500 | 500 |
| 1000Base-F Fiber Port Upgrade |  |  |  | 500 | 500 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Total Number of Patch Cables Needed** | **Price per Patch Cable** | **Total Cost** |
| Fiber 1 GbE patch cables | 1 | $100 | 100 |

***Lab B***

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Number of Patch Cables Needed** | **Price Per Patch Cable** | **Total Cost** |
| UTP Cat 6 Cable | 1 | 60 | 60 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Number of Client Devices in Lab** | **Number of Ports per Switch** | **Number of Switches** | **Price per switch** | **Total Cost** |
| 10/100/1000Base-T Ethernet Switch(es) | 1 | 48 | 1 | 120 | 120 |
| 1000Base-F Fiber Port Upgrade |  |  |  | 500 | 500 |

***Lab C***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Number of Client Devices in Lab** | **Number of Ports per Switch** | **Number of Switches** | **Price per switch** | **Total Cost** |
| 10/100/1000Base-T Ethernet Switch(es) | 1 | 48 | 1 | 120 | 120 |
| 1000Base-F Fiber Port Upgrade |  |  |  | 500 | 500 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Total Number of Patch Cables Needed** | **Price per Patch Cable** | **Total Cost** |
| UTP Cat 6 cables | 1 | 60 | 60 |

***Cost per Classroom***

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Total Number of Patch Cables Needed** | **Price per Patch Cable** | **Total Cost** |
| UTP Cat 6 cables | 1 | 60 | 60 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Number of Client Devices in Classroom** | **Number of Ports per Switch** | **Number of Switches** | **Price per switch** | **Total Cost** |
| 10/100/1000Base-T Ethernet Switch(es) | 1 | 24 | 1 | 750 | 750 |
| 1000Base-F Fiber Port Upgrade |  |  |  | 500 | 500 |

**Total Cost for Classrooms: (Cost per classroom \* 3)\_\_\_\_\_\_\_\_3930\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

***Office Area:***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Number of Client Devices in Office Area** | **Number of Ports per Switch** | **Number of Switches** | **Price per switch** | **Total Cost** |
| 10/100/1000Base-T Ethernet Switch(es) | 1 | 24 | 1 | 500 | 500 |
| 1000Base-F Fiber Port Upgrade |  |  |  | 800 | 800 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Total Number of Patch Cables Needed** | **Price per Patch Cable** | **Total Cost** |
| UTP Cat 6 cables | 1 | 60 | 60 |

*Total Wired Infrastructure Cost for Classrooms, Labs, and Office Area:*

$ \_\_\_\_\_\_\_\_\_\_\_\_\_\_1360\_\_\_\_\_

**SERVER ROOM NETWORK WIRING COSTS**

Much of the equipment for the Server Room has already been purchased including the racks, UPS system, file servers, database server, storage server, router to campus network, and storage area network components. Cost estimates are needed for the server room access switch and the switch that will serve as the backbone distribution switch for the building. Cost estimates for the fiber optic patch cables are also needed.

**Task 5:** Your fifth task is to identify aggregate costs for the cabling and backbone switch in the Server Room.

To complete this task, you need to identify and apply appropriate equipment and cabling prices in Figure 8-16 (page 244 of textbook).

***Note:*** The following tables are provided to enable you to systematically aggregate cost estimates for the hardware needed in the server room.

***Server Room: Building Distribution Switch***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Number of Access Layer Switches Supporting Classrooms, Labs, Office Area, Server Room Network and Wireless Overlay Network** | **Number of Ports Needed** | **Number of Switches** | **Price per switch** | | **Total Cost** |
| 10/100/100Base-F Ethernet Switch (Building Distribution-layer switch) | 1 | 24 | 1 | 1000 | | 1000 |
| 1000Base-F Fiber Port Upgrade (for connection to router) |  |  |  | |  | 1000 |

***Server Room: Server Access Switch***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Number of Servers and SANs** | **Number of Ports Needed** | **Number of Switches** | **Price per switch** | **Total Cost** |
| 10/100/1000Base-F Ethernet Switch | 1 | 48 | 1 | 1000 | 1000 |
| 1000Base-F Fiber Port Upgrade (for connection to building distribution switch) |  |  |  | 500 | 500 |
|  |  |  |  |  |  |

***Server Room: Fiber Optic Patch Cables***

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Total Number of Patch Cables Needed** | **Price per Patch Cable** | **Total Cost** |
| Fiber 1GbE patch cable | 1 | 100 | 100 |

*Total Wiring Cost for Server Room:* $ \_\_\_\_\_\_\_3600\_\_\_\_\_\_\_\_\_\_\_\_

**WiFi NETWORK COSTS**

**Task 6:** For Task 6, you will estimate costs for the wireless overlay network that will support the new wing of the Computing Sciences Building at SSU.

**Note 1:** Network designers indicate that eight Power over Ethernet access points will be sufficient for the new wing. One for each classroom and lab, and two for the office area.

**Note 2:** STP Cat 5e patch cable will be used to connect the access points to a PoE switch.

Cost estimates for the wireless LAN can be summarized in following table.

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Quantity Needed** | **Cost per Unit** | **Total Cost** |
| Access Point with PoE |  |  |  |
| 10/100/1000Base-T Ethernet Switch | 1 |  |  |
| PoE Upgrade for Switch |  |  |  |
| STP Cat 5e Cable |  |  |  |

WIRELESS OVERLAY NETWORK CHANNEL ALLOCATIONS

To minimize interference and maximize performance of the WiFi network, non-overlapping WiFi channels will be used in adjacent access points. Figure 7-9 in the textbook provides guidance on how differences channels can be deployed in a facility such as the new wing of the Computing Sciences building.

Add channel allocations to APs in your wireless network diagram or create a separate diagram to illustrate how channels will be allocated to the APs.

SOFTWARE CONSIDERATIONS

Network Operating System: SSU plans to use the most recent version of Windows Server on the file servers that will support the new wing of the Computer Sciences Building. To do will require the purchase of a copy of Windows Server® Datacenter Edition (2 Core) for each application server as well as purchasing a sufficient number of client access licenses (CALs) for each of the *permanent* computers in the classrooms, labs, and administrative offices in both segments. Each client computer that is permanently installed in each classroom, lab, and office must have a CAL. CALs for laptops brought into the building wing by students are not needed

Application Software: SSU plans to use provide the most recent versions of Microsoft Office 365 Business Premium, Microsoft Project Professional, and Microsoft Visio on each of the computers permanently installed in the classrooms, labs, and offices. To do so will require the purchase of sufficient software licenses to equip each of the permanent computers in the classrooms, labs, and offices.

Note: The application software will be installed on all instructor workstations in classrooms and labs and on all *permanent* PCs in labs and offices.

Cost estimates for the network operating system, CALs, and application software should be provided.

Note: As a university, SSU qualifies for Microsoft’s educational discounts (60% off retail prices).

**Collaboration Exercise 3 Submission Checklist**

You should submit your assignment in electronic or print form on or before the specified deadline. The package that you submit for this assignment should include:

1. A title page that provides a descriptive title for your project and lists each member on your team that contributed to completing the assignment.
2. A table of contents
3. All specified diagrams (Tasks 1, 2, and 3) for the building backroom network, server room network, and wireless overlay network.
4. All specified cost estimates for the cabling and switches for the labs, classrooms, and office area in the new wing of SSU’s Computing Sciences Building (Task 4).
5. The aggregate costs for the cabling, access switch, and backbone switch in the Server Room. (Task 5)
6. Costs estimates for the wireless overlay network hardware that will support the new wing of the Computing Sciences Building at SSU (Task 6).
7. Cost estimates for the network operating system and application software that will be used in the new wing.
8. Wireless channel allocation illustrated either in wireless overlay network diagram or separate diagram.

**Upload your files associated with the assignment to Folio by the specified due date *or* submit a hard copy to your instructor’s office:** ***IT Building 3148***