COMP 10019
Network Design Proposal Assignment

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Introduction

The first half of our course has been an exploration of networking terminology, technologies and key knowledge areas; however, it is always much more interesting to apply this understanding to a real-world situation!

To get a feel for using our knowledge in a business setting you are going to form teams of five and tackle a case study, where your group will:

1. Identify the technical requirements for a network given a written description of the company and its desired networking objectives.
2. Design a 3-tier logical network for the company given specific parameters (employee count, departments, number of floors) and the floorplan.
4. Design a physical network design by correctly applying TIA/EIA-568 structured cabling rules to the office layout.
5. Investigate and document key component costs of the finished network (e.g. cable plant, switch and router infrastructure, etc.).
6. Submit two documents and two video presentations by their respective due dates.

The remainder of this document describes the assignment in detail, explains how you will be evaluated, and discusses the template that you will use to complete your assignment.

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Before You Begin *(DO THIS ASAP)*

The first step in completing this assignment is to form a group of **five** students **that are in your section of the course** and for all the members of your group to join one of the open groups via the **People** link on the course page.

You and your team can simply join the first available group. Note that anyone can use this tool to join a group that is not full, so if someone accidentally joins your group and takes up a slot you were holding for someone else you will have to ask them to leave the group and join another one, so it makes sense for everyone in your group to join the same working group at the same time.

The Network Design Proposal

The overall objective of this assignment is for you and your group to demonstrate that you have understood the role and likely location of various elements of an enterprise network by creating a high-level network design proposal for a fictional local business that you will be assigned.

You and your group are acting as a network design company bidding for a contract to build out a new network for the business you have been assigned. Feel free to give your group a fun company name – after all, who's going to contract "Group 13" to build their enterprise network?

You can assume that the business will be using several internal applications, including in-house e-mail services, two physical application servers, twelve virtualized web-based application servers (these applications are for internal use) on two physical hosts, one file server per 200 employees, and two physical application servers specific to the business (you may specify what these are – have fun with it!). The business already owns a suitable number of network-connected printers, as well as the computers and VOIP Phones for each and every employee, so you do not have to factor purchasing those into your project.

Your network design *will* need to take into account:

- The volume of network traffic there will be to each server (there's a tool to help with this!)
- The amount of traffic that will be generated on each cable segment
- The infrastructure and hardware required to support the traffic, including the key network devices (e.g. routers, switches, etc.)
- The proper contents of a suitable number of wiring closets to ensure the cabling standards are respected (cable length limits must be adhered to)

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Your project deliverables will be:

1) An initial communication to the company indicating that your "company" intends to bid on this network buildout (note that the structure and contents of this message are detailed later in this document).
2) A short video intended to simulate an initial video call with the client to present the high-level (only) details of your proposal, which will allow them to give you feedback should anything look amiss (again, details on what is required here are articulated later).
3) A final proposal document summarizing the design choices your group has made (a template for this document has been provided).
4) A video presentation of your proposal (see the notes around this for requirements, including length and structure).

I hope your group wins the contract for this job!

Tools and Information Required

Your group will need to use the following tools and support documents:

- **Microsoft Visio*** (this is available for free from Mohawk via Microsoft Azure Dev Tools – see the Software section), **OR** you can use the free online drawing program hosted at **https://draw.io** – if you want to use a different network drawing tool you should seek approval from your professor (this is simply to ensure that the tool you want to use will be up to the job)
    - A good Visio tutorial is available on LinkedIn Learning
    - You'll likely find that draw.io is easier, for our purposes, for *one* of the deliverables, but that Visio will be indispensable for the physical layout portion of the assignment
- The **Network Design Proposal document template**
- The **Logical Network Design example drawing** (included in this document)
- The **Physical Network Design example drawing**
- The **DesignAssistant.xlsm** spreadsheet
- The **DepartmentBandwidthBalancing.xlsx** spreadsheet
- The **CablingAssistant.xlsx** spreadsheet
- The **CostingAssistant.xlsx** spreadsheet

* while you are free to use Visio 2019 (or newer) , this document assumes you are using Visio 2016 and contains instructions relevant to that version – sorry…

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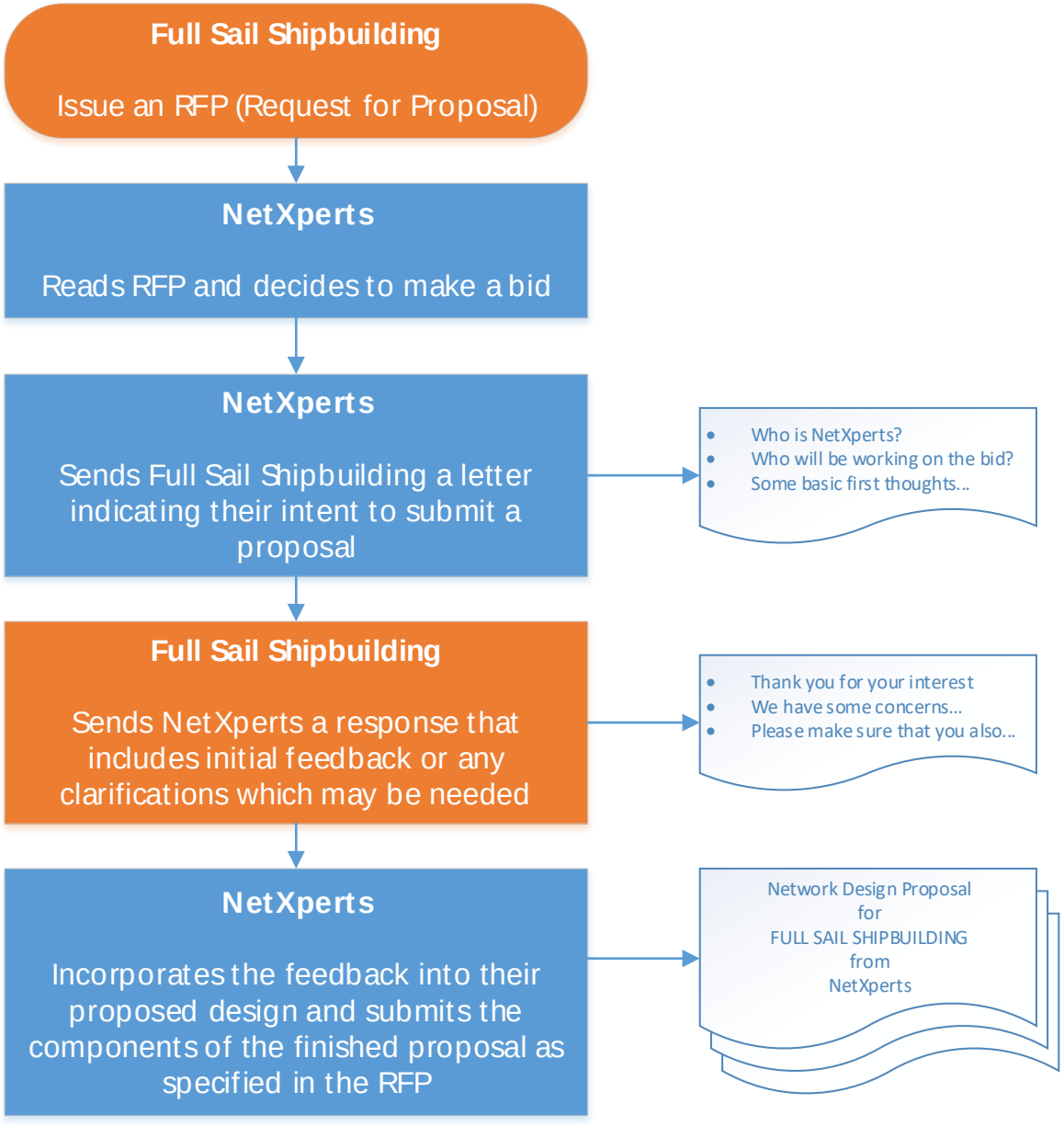
Your First Task: The "Intent to Respond" Letter

We would like to take note of who will be bidding on our network buildout job, so I want your team to submit an "Intent to respond" letter to the Document dropbox (don't submit it to the Presentation Dropbox). So, what am I asking for?

The idea behind this project is that you are part of a network design firm that is putting together a proposal to meet the networking needs of the company in your case study. Let's look at how this would work in the real world with a fictional company called "Full Sail Shipbuilding" seeking a network proposal, and a network design firm called "NetXperts" who would like to submit a proposal:



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So, your team is going to submit an **intent to respond** letter which will:

- Contain your company name, logo, etc.
- Specify the names of the group members and the roles they will play in your team
- Restate what the company in the Case Study is requesting
- Contain an initial list of the components you are likely to include in your final proposal (don't be overly detailed here)

An example of this kind of letter has been uploaded to the same course content area in which you found this document.

Make sure to upload it on time! This submission is worth five marks and you'll lose one mark per day that it is late. Note that this submission is *required*, so even if it's more than five days late you'll need to submit it if you want me to mark your final submission.

Your Second Task: The "Video Call"

The client wants an update on the progress of your design work, where they can review your likely hardware and cabling recommendations, costing, etc. They want to do a video call – now, while I'd love to be able to actually do a video call with each team that will prove to be pretty impractical. So, we're going to fake it!

Your team will upload a ~5 minute video with the content that would normally be in a video call – mainly, a high-level overview of the various parts and overall plan you a proposing for this buildout.

In response, a representative of your case study company (your Professor) will upload a video containing their side of the call. In this response they will articulate any concerns, questions, or issues they have with the proposal as presented. You will incorporate this feedback into your final proposal – there is no need to "reply" to their response (of course, if you have questions you should follow up with your Professor ASAP).

Make sure that you upload the "video call" by the deadline – late submissions will pose two problems:

1) You and your team will lose marks – this submission is also worth five marks and you'll lose one mark per day that it is late. Note that this submission is *also required*, so even if it's more than five days late you'll need to submit it if you want me to mark your final submission.
2) Your team will have less time to address any issues or problems noted by the client.

The length of the video should be about five minutes, but I will not deduct marks for a longer or shorter submission. It must, however, cover the proposed cabling plant choices (including TOs, cable types, etc.), proposed infrastructure hardware choices, and the estimated total cost of these elements.

Remember, this is supposed to simulate a quick video call with the client, where they are looking for a status update on the proposal. They don't want exhaustive detail, just the highlights. You don't need to cover every single aspect, but you do need to cover the above items. It is 100% acceptable for this submission to differ wildly from the final design as you are allowed to change it before submitting the final proposal and presentation.

Your team will earn full marks if the submission is on time, the company can understand your presentation, and the required elements are all included.

You'll get a response from the company ASAP, so make sure you pay attention to any feedback you get from them and apply it to your work as you complete the proposal.

Office Layout

Your RFP package will be a ZIP file that contains the case study information document as a PDF file and will also include SVG blueprint files that you can import into Visio. These blueprints represent the new space into which your case study company – the "client" – is moving their operation. Unzip the case study ZIP file to access the contents.

There will be one file per floor of the client's new building. You can import those files into Visio through this process:

1) Start the program and create a blank drawing.
2) When the drawing opens, open the "Design" ribbon and click the "Orientation" button.
3) Select "Landscape".
4) Open the "Insert" ribbon menu and click the "Pictures" button.
5) Browse to where you extracted the RFP package.
6) Select the first floor file (only) – it should be called "floor1.svg" – and click the "Open" button.
7) Once Visio has imported the drawing, click the button underneath the drawing area that looks like a plus sign in a circle – this will create a second tab.
8) Repeat steps 4 through 7 until you have imported all the floors onto their own tabs.

Each office area is labelled with the department and how many workstations will be in that office – for example, the label **Finance (6)** indicates that the labelled office area will be used by the finance department and will have 6 offices within it. Note that you can move any of the text elements that aren't in the best position. Grey boxes indicate the location of stairs and/or elevators.

Once you come up with a workable design you can mark up the blueprints with your information. Don't start with this part – do the Logical design work first. When you've completed your design you can export them from Visio as a picture that you can attach to your proposal document. You must ensure that the drawings are clear and legible, and that they accurately reflect your design – if they are not consistent with how you describe the proposal in the document and/or your final presentation, you and your team will lose marks. The rubric document explains the weight of the various elements and how they will contribute to your final project mark.

Your diagrams will provide the external dimensions for the building and, as mentioned, indicate the major office spaces where each departments end user workstations are located. These diagrams will be the starting point for a subsequent step where you will specify the location of cabling runs, server locations, etc.

Your group must develop your own unique network layout diagram based upon the Physical Layout information specified in your specific case study. Your initial, empty floor diagrams must be embedded as an appendix in your final Proposal document.

For editing the diagrams the recommended drawing solution is Visio (which you can download and use for free via Microsoft Azure Dev Tools), but you may also use an online application called draw.io (https://draw.io). Visio has some quirks related to connectors that many students find very frustrating if they have never used Visio before, but it does have an office layout mode which is very convenient for this part of the assignment. If your group chooses to use draw.io then see the "Logical Network Diagram" section in this document for instructions on how to export your drawing as an image. Groups using Visio can export the diagrams as images or copy-and-paste their diagrams into MS Word. Not sure? Use Visio (trust me).

The best way to start the assignment is to fill in the first worksheet of the DesignAssistant.xlsm spreadsheet with the names and sizes of the departments featured within your assigned company. These values are in the RFP document and should be reflected on the blueprints. The spreadsheet will then give you floor space requirements for each department that you can use to estimate cable lengths, and so forth. Your company profile will also indicate how many floors the offices are to be spread across, which, when combined with the floor space requirements, will tell you how large the buildings are.

When working on your layout you should try to ensure things are properly sized and to scale, but make sure the group as a whole does not spend too much time on this. Divide and conquer.

The following is a step-by-step procedure for creating your office layout drawing in Visio. It assumes you are using Visio 2016 Pro (or earlier) so the screenshots included here may reflect menu items and icons that could be slightly different in your version.

Procedure

1. Populate and double-check the output of the DesignAssistant spreadsheet regarding the space required for each department and their staff. The DesignAssistant tool includes an overhead value to take hallways and walls into account.

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Employees	Dept	Area/Employee (m^2)	Area Required (m^2)
12	Executive	20	240
65	HR	12	780
45	Finance	12	540
50	Legal	15	750
35	IT	10	350
48	Department 6	10	480
33	Department 7	10	330
20	Department 8	10	200
120	Department 9	10	1200
82	Department 10	10	820
90	Department 11	10	900
Total Employees: 600		Total Office Area	6590 m^2
		Overhead (20%)	1318 m^2
		Total Floor Space	**7908 m^2**

You are not required to submit a copy of the tool's results. It is likely that many of the offices will be larger than needed to accommodate building layout, anticipated growth, etc.

2. Note that many floorplans will include unused or extra space on floors for future growth.
3. You may find that large departments are spread across several office areas, even if those offices reside on different floors. For example, if a department requires 600m^2, 200m^2 of their space may be on floor 1 and the remaining 400m^2 on floor 2.

   Note the various locations of a given department, and consider renaming them by editing the text elements (ie. **Finance-1**, **Finance-2**. This will make it easier to document your cable runs.
4. The floorplans should include washrooms, meeting rooms, stairs and elevators. They should also include utility closets, labelled **CL1**, **CL2**, etc. which you can use for TRs.

   Important Tips:
   - The hallway spaces between offices have a false ceiling (also known as a drop ceiling) with plenum space above the tiles. All the offices also have the same false ceiling configuration.
   - Office areas will have sufficient space for telecommunications cabinets, should your team decide to use them.
   - There are undoubtedly building codes governing the placement of doors, halls, exits and elevators – however, as this is not a course in building architecture your group should simply assume the floorplans are acceptable to the local authorities.
   - Remember that you have a limited amount of time to complete this assignment, so if you find your group is spending too long on marking up the floorplan you will want to have a few group members working ahead on the next parts – divide and conquer!
5. Don't forget to add a statement of authorship to your drawings

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To insert the drawings into your final report, select all of the elements of the drawing, then click "Copy" on the "Home" ribbon. Paste the drawing into your Word document and double check that all elements have successfully been copied over.

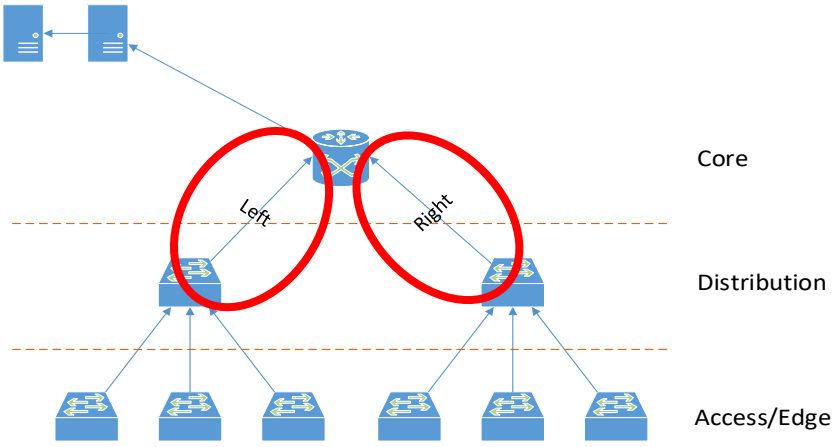
Balancing Network Traffic

This is a very important stage in your plan. One of the most obvious objectives for all network designs is to deliver excellent performance for all users. Balancing traffic flow and ensuring that network data and applications are logically located in relation to departments are two methods of increasing network performance that don't require significant additional expense in most cases.

This information will be used to help us plan the physical design of the network.

For our course, let us assume that we will all be using a 3-tier model with core, distribution and access (or edge) layers. We will also assume that our design will use two distribution devices (in the real world you would likely have more than two, but we will keep it simple for the purposes of our course). For a review of the 3-tier model, see the corresponding slides on the MyCanvas course page. Your design should place all servers in a central location for security purposes.

Balancing traffic is a process that ensures that no part of the network is unduly overloaded. Let's look at a basic example:



The goal is to balance (as best as possible) the traffic on the left and right trunks. Sounds good, right? So how will your group do this? Well, we have a process for you:

Procedure

1. Open the DesignAssistant.xlsm spreadsheet tool that we have provided within this module area, and scroll down to the calculated application and department bandwidth.

   The workbook consists of two worksheets. The first requires input from you, and will then show you how much space you'll need to allocate for each department, which will help you draw the office area for your assigned business. The second sheet automatically calculates bandwidth requirements and comes up with a reasonably balanced division between departments, assuming you only need two distribution devices. Your design

may require more distribution devices, but given the capacity of modern devices you may be able to limit your design to two.

2. You will want each department to be connected to an access-level device, which are in turn be connected to distribution level devices. You should ensure that trunk traffic is relatively balanced across the network. You will be using at least two distribution level devices so there will be at least two trunks for which we are balancing traffic. Again, a real-world design may require more trunks, but as we mentioned we will limit it to two for this assignment.

    3. From eLearn, locate and fill in the department bandwidth balancing document. This sheet will help you finalize the traffic balance across your network. Ensure this sheet arranges your departments such that the "left" and "right" trunk is relatively balanced – the DesignAssistant spreadsheet should do a lot of the work for you. If you want to do this manually, you can simply assign the department with the highest traffic the "left" side of the network, then assign the department with the next highest bandwidth to the "right" side, then continue to assign departments alternating between left and right sides until you are complete:

Department Bandwidth Balancing

Group:
Company Name:

Left Trunk	
Department	Bandwidth (Mb/s)
Total	0 Mb/s

Right Trunk	
Department	Bandwidth (Mb/s)
Total	0 Mb/s

Copy the department names and their corresponding bandwidths into the blue boxes on this sheet. You may need to experiment to get the left and right halves to balance well, and if you find one or both trunks exceed the capacity of current distribution level devices, consider adding a third (or fourth) trunk – you will then need to manually balance across your trunks as the DesignAssistant spreadsheet assumes two trunks.

If you cannot balance your traffic evenly don't panic as a slight imbalance is acceptable!

4. If you have one or two departments that consume most of the network bandwidth, you may have to allocate departments to network branches differently such that end result is approximately balanced.

Logical Network Diagram

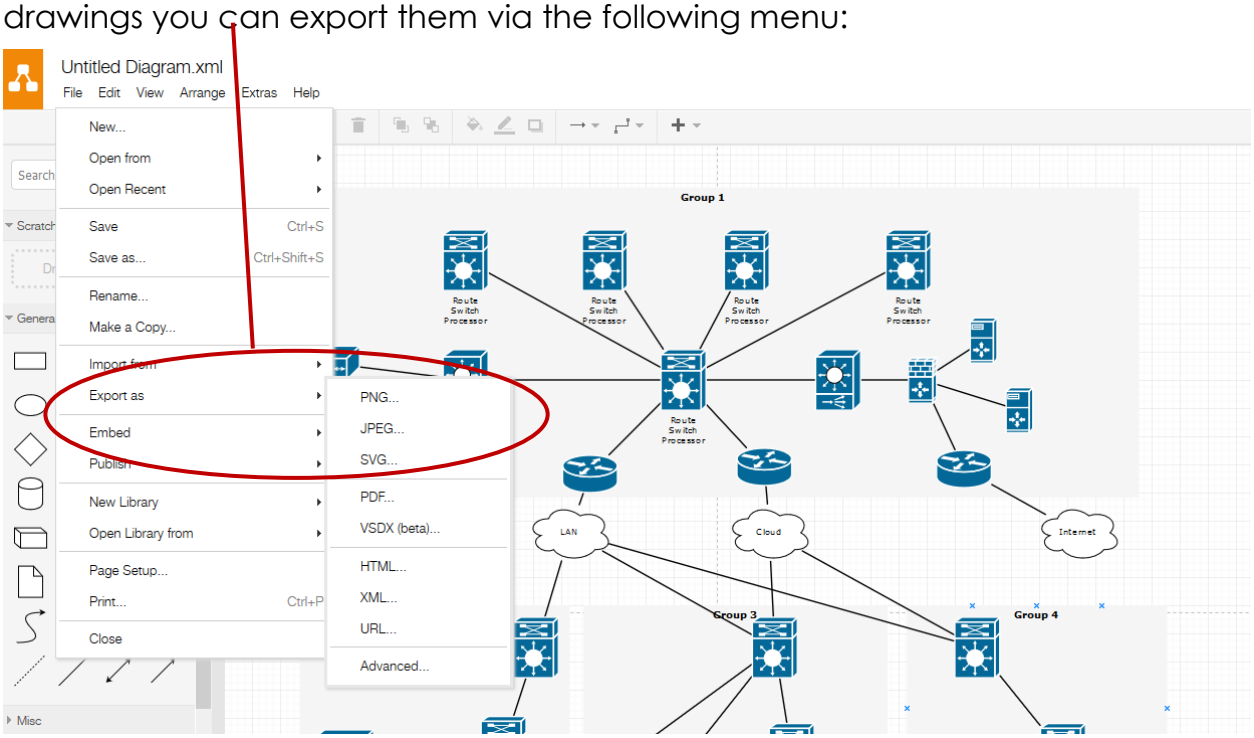
A logical network diagram is intended to show the overall network organization without specifying exact details of how the network will be implemented. Cabling and switch/router types and models, for example, will not be defined as part of a Logical Network Design.

On your logical network diagram, you need to show the following:

1. All departments and their corresponding traffic and employee counts.
2. All servers.
3. The total internet traffic.
4. The distribution-to-core traffic for each trunk.

For this diagram the recommended drawing solution is, as mentioned, an online application called draw.io (https://draw.io). You have the option of using Visio, but there are some quirks related to connectors that many students find very frustrating. Furthermore, draw.io includes most of the standard Cisco networking symbols, which is nice. Use draw.io for this part of the work. Trust me.

NOTE: You will need to export your completed diagram in an image format so that you can embed it in your proposal document. Visio users can copy-and-paste their drawing into the document, but to properly export diagrams.net drawings you can export them via the following menu:



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Procedure

1. Show all your departments connected to a *unique* access level device.
2. Do *not* share an access device between departments.
3. Enter each department's traffic between the access and distribution level devices. Use the results of the DepartmentBandwidthBalancing spreadsheet to determine which departments are associated with which distribution level device.
4. Add up the total access level traffic and enter that on the distribution–to-core trunk.
5. Add in all the servers that are hosted internally within the company (see the DesignAssistant spreadsheet to see how many physical servers this will be). Show their respective bandwidths.
6. Enter the total internet traffic.
7. If your team is going for the Wi-Fi bonus marks, add in access points for a wireless network. Don't forget to add any necessary infrastructure to your data centre. Don't worry about adding a "perfect" number of access points, a few will be sufficient. No traffic numbers need to be shown or considered for this part of the network.
8. Embed your drawing into the correct section your Proposal document.
9. Your physical network diagram must reflect the decisions you made with this drawing – you will need to ensure they are consistent.
10. Don't spend too much *group* time on this – divide and conquer so that your team of five can get the work done within the allotted time (see the Work Breakdown and Approximate Time Requirements section of this document).

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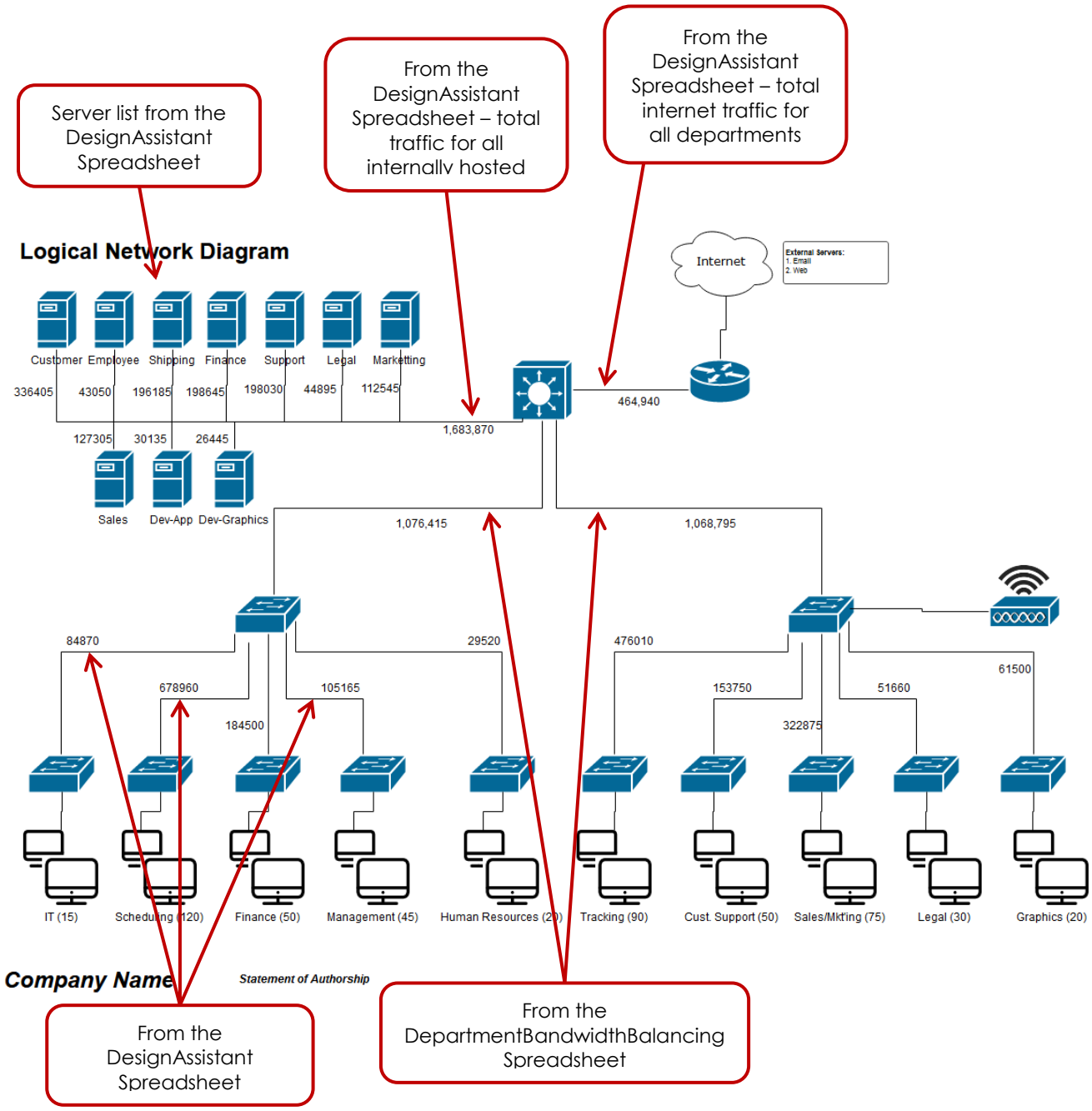
Sample Logical Network Diagram and Source of Traffic Numbers



Physical Design and Costing

Once your team has a logical design that you are happy with it is time to place those devices on your office layout diagram.

The **primary objective** of this part of the assignment is to **design and document the physical topology** of your proposed network based upon the specifications you have identified in earlier. Your group's design must reflect the requirements of the business that you have been assigned and the decisions you made when you designed the logical network layout.

Whenever you make a design decision, you should consider recording your reasons at that time since so you can include this rationale in your document and, likely, in your presentation video. The specific hardware choices you make in this phase of the project will influence the cost of your network infrastructure that you will need to articulate and include in your document and presentation.

The major things you'll need to include within your design are as follows:

1. Document the physical location for servers, which you can assume have already been purchased and will not need to be included in your cost estimate.
2. Document the location of all network devices and related infrastructure components (e.g. switches, routers, telecommunications rooms). These items will need to be included in your cost estimate. **Note that you may find that the length of your vertical and horizontal cabling runs are short enough not to appear to need more than one TR per floor, but because businesses grow and periodically reorganize their offices this rarely works well in the real world (trust me on this one) – so you should plan to have more than one TR per floor.**
3. The location of the EF and ER (data centre). Note that you may want to use an external modular data centre (a popular modern option for many businesses).
4. Document the cable types and cable run locations.
5. Determine and cost the amount of each cable type that will be required.
6. You do not need to include labour costs in your proposal. While this is not realistic in a real-world setting, for our purposes your labour will be free. ☺
7. Don't forget to include a legend, so that mere mortals can understand your fine work.

There should be examples posted to the MyCanvas course page to help guide you through the process.

Don't forget to divide and conquer: have someone on your team working on this in parallel with other steps of the project.

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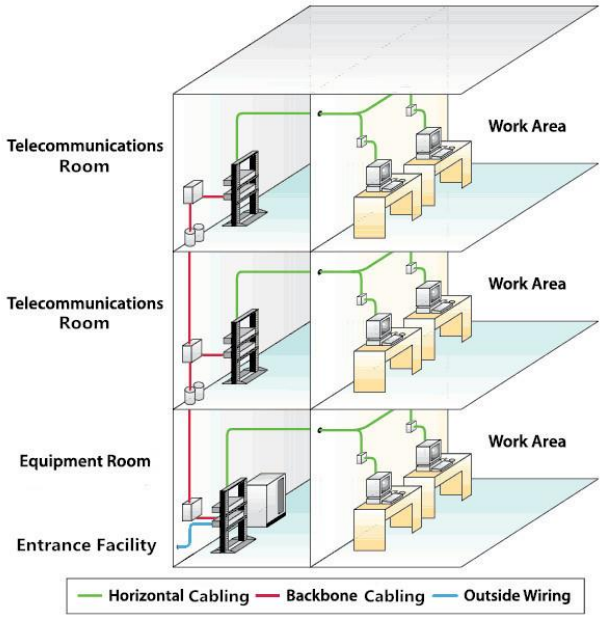
Procedure

1. Refer to the Structured Cabling section of Module 2 to remind yourself of the rules and requirements of the TIA/EIA-568C specification.

   For your reference, the diagram below summarizes the various structured cabling components:



   You'll notice that this image uses green lines to represent the horizontal cable runs to the various work areas, red lines to represent backbone/vertical cables, and blue lines to represent cable runs originating with the external network connectivity supplier. While you won't be drawing all of these runs on your diagram, you will probably want to define a consistent colour scheme to help make it clear the purpose of any given cable run on your diagram.

   For this project, you may run backbone/vertical cable only in plenum spaces above halls or open spaces. Therefore, make sure that your Entrance Facility, Equipment Room, Telecommunications Rooms and Telecommunications Enclosures are in an office area and located adjacent to a hall.

   The ER, TRs, and TEs all contain active network devices. This includes Access levels devices that will service various departments located on the same floor.

   The ER should be "attached" or enclosed within the IT office area.

   The following images are examples of acceptable and unacceptable EF/ER locations:

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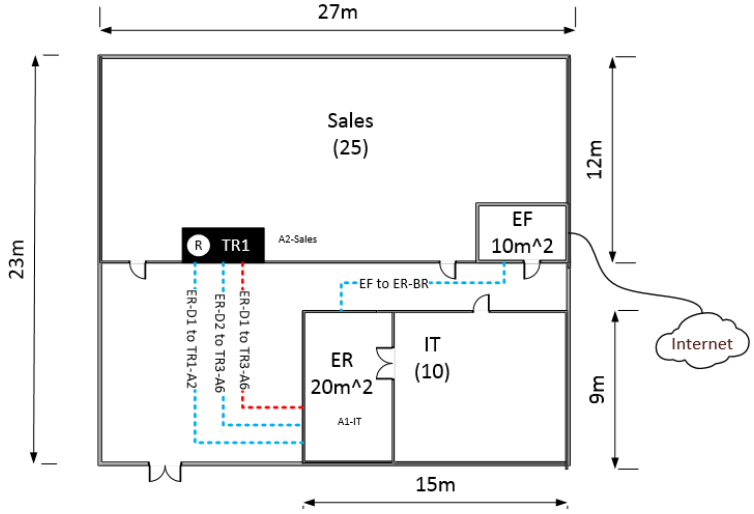
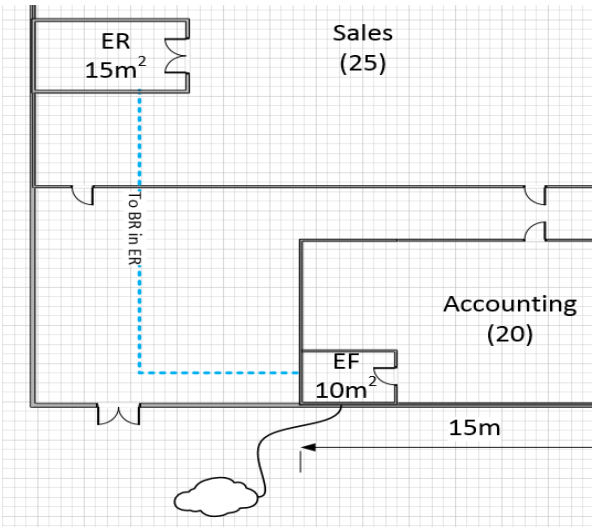
Acceptable



- ✓ The ER opens to the IT department (if the ER/EF are in a non-IT department, we strongly suggest the door open to the hallway)
- ✓ Backbone cabling runs throughout hallways (through conduit, presumably, and/or through plenum space)
- ✓ The EF is large enough and is on an external wall, which makes sense, and shows the demarcation point
- ✓ The ER, TR, and EF are adjacent to hallway for easy cabling
- ✓ Only backbone cabling is shown – horizontal and work area cable is not to be shown on this diagram (it will be too busy, and given that offices routinely reconfigure seating arrangements, it's not a priority here)
- ✓ Access level devices contained in the TR and ER and the departments those switches service are listed

Unacceptable



- ✘ Both the EF and ER opens to non-IT department
- ✘ Backbone/vertical cabling has been run in office space
- ✘ The ER is not adjacent to hallway
- ✘ The access level devices contained in the ER are not listed

Don't forget that a Telecommunications Enclosure (TE) is, essentially, a scaled down version of a Telecommunications Room (TR) that houses a horizontal cross-connect (transition between backbone and horizontal cabling) and it's a floor level service device like a TR: both TRs and TEs can only serve the floors on which they are located and both TEs and TRs can contain active devices.

The TE has no functional advantage over a TR. The TE is simply smaller and therefore less expensive than the TR. It is your group's decision if you want to use TEs – they may be useful in floor layouts where you simply cannot find room for a TR (this is rare – see the "acceptable" diagram above).

Shown below are examples of TR's and TE's:

TE Examples **TR Example**

Again, your group should refer to the Structured Cabling information in your notes and textbook when locating your cabling elements.

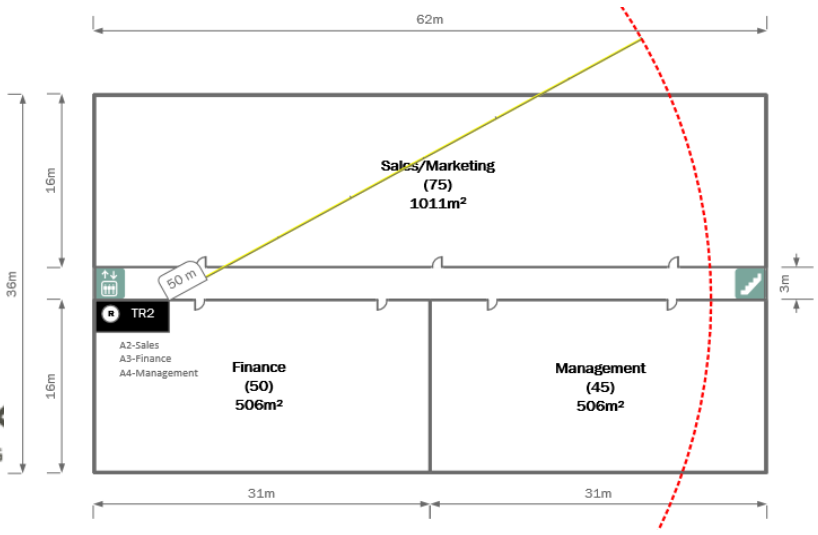
Important: The EF, ER and TRs will take space away from the offices in which they reside, which may result in less space per person than the floorplan and DesignAssistant have suggested. For the purpose of this assignment, that's OK.

2. Locate the EF. It MUST reside on an exterior wall and, unless it is combined with the ER, MUST be located adjacent to a hallway. The EF should be on the ground floor or basement and MUST be at least $10m^2$.
3. Locate the ER. Put it within the IT department, if you can. Otherwise, if you locate it in a non-IT department, it should open to a hallway. Consider putting the EF within the ER. Or not. Your call.

4. The ER will contain racks of equipment that house the company's:
   - Core network devices
   - In all likelihood, your network distribution level devices, and any access level devices for one or more departments on that floor
5. Your design will contain <u>just one</u> ER. As per the video, you may want to explore using a containerized data center outside of the building. I like this idea, particularly if there is no designated or available space for a data center on the floorplans. An otherwise unused office area also makes for a suitable data centre location.
6. From the ER, backbone cable will fan out to access switches deployed across your company. Backbone cable may run horizontally through hallways (in the ceiling via cable trays or conduits) or vertically through risers. Therefore, it makes sense to locate a riser in the ER that will go up/down to other floors in your building.
7. Risers MUST be aligned floor-to-floor. Do your best, but don't spend days micro-aligning your diagrams – this is a school project. ☺
8. Beside your ER, TRs, and TEs, add a note showing the Access switches it contains and the departments those switches serve. See the examples in the next step for details.
9. Each floor MUST contain at least 1 TR. The ER may serve as the TR for the floor on which the ER resides. A TR is the horizontal cross-connect coupling backbone cable and horizontal cable for that floor, therefore, they contain Access or Edge devices and possibly a distribution device.

Office Area Coverage

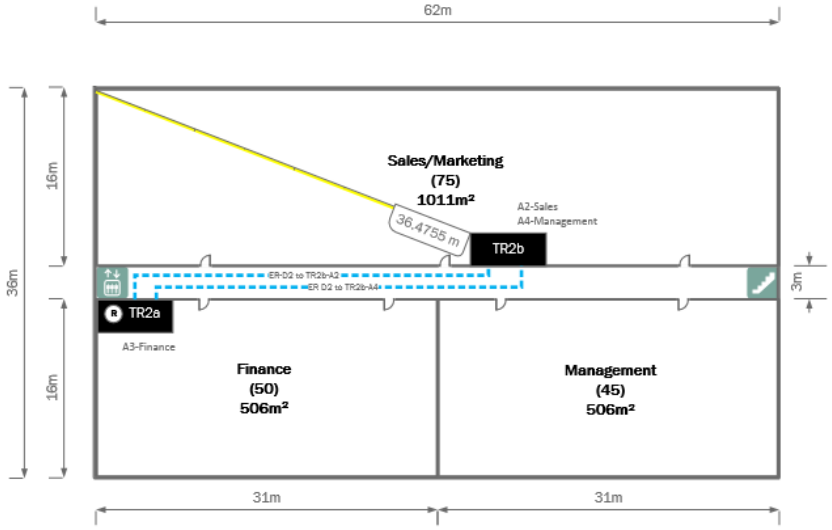
The TIA/EIA-568C specification allows for up to 90m of cable between the horizontal cross-connect and the user's work area Terminal Outlet (TO). Because the path of the horizontal cable includes vertical distances (switch to ceiling, ceiling to TO) and possibly an obscure horizontal path, to simplify things we can make a design check that the access level device located in the TR MUST be <= 50m from all office areas that it serves. If your group cannot position the TR within a 50m radius of the office area it serves then you need to add an additional TR or TE to that floor. The following diagrams illustrate this:



In this case, TR2 contains 3 access level devices – A2, A3, and A4 – which together service all the end user devices on this floor. This is clear from the way the labelling has been applied. However, according to our 50m design check, some areas of the Sales/Management and Finance offices will not be completely covered.

The Visio "**Measure**" tool was used to check the distance from the switches. If your group is not using Visio do your best to estimate this, given your room sizes.

The solution is to add either an additional TR or a new TE on this floor with corresponding access switches to completely service this floor:



Notice the changes that were made:

a. TR2 was renamed to TR2a and a new TR was added to the floor – TR2b
   Note: A TE could have been used here instead

b. Access level devices A2 and A4 were moved from TR2 to TR2b, which is within 50m of the all the office areas it covers – Sales/Marketing and Management

c. Backbone cabling was added showing a connection between the Distribution level device in the ER to the Access level devices in TR2b – even though this backbone cable also travels vertically down to the ER to keep things clean vertical runs of backbone cable do not need to be shown on this diagram

Also notice that the two TR solution could have been avoided (along with the extra backbone cabling) by positioning TR2 more centrally in the original diagram. However, even with centrally located switches in a single TR, it is not always possible to obtain complete coverage for a floor – it depends on the physical layout of your office. Again, this is your call – you are the designers!

Use these guidelines when placing your structured cabling components:

- While you should closely follow the physical topology examples, the examples show a slightly different way of labelling backbone cabling – use the method presented in this assignment instead. Sorry about that.
- Beside each EF, TR and TE ensure that you list the access level devices that it contains and the department(s) they serve.
- Backbone cabling must be run in hallways or risers only.
- TRs, TEs and Risers do **not** need to be drawn to scale (yay!).

Infrastructure Components – Backbone, Horizontal and Work Area Cabling

As mentioned, for the purposes of this assignment you are only to show backbone/vertical cabling – work area/horizontal cabling is not to be shown.

Backbone Cabling

There are two considerations when selecting your backbone/vertical cabling – cable type (i.e. fibre or wire) and redundancy. Consider the following when making your decisions:

- If a backbone/vertical cable run is going to be longer than 100m fibre must be used regardless of cost considerations (100m is the general limit for UTP copper cable).
- Redundancy adds cost and complexity while improving availability. Most businesses would like some redundancy at the core level, but it's up to you. You may want to make redundancy a "suggestion for future improvements".

You must label your backbone cables on your Physical Topology diagram with colour and line types that are consistent with your legend. Backbone cables must be labelled with their destination and the network device. Since all the distribution level devices will be located in the equipment room, only access level devices should be shown on backbone labels.

Here are some backbone labelling examples (don't forget the example documents show a slightly different method of labeling backbone cables and you should use the method shown here instead):

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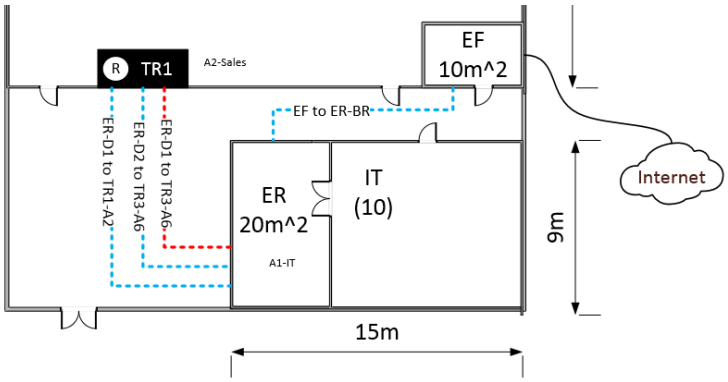

Reading the codes:

1. "ER-D1 to TR1-A2" indicates a backbone cable that runs from "Distribution level device 1 in the Equipment Room to Access level device 2 in Telecommunications Room 1".
2. "ER-D1 to TR3-A6" indicates a backbone cable that runs from the Equipment Room to the Telecommunications Room on floor 3 and is connected to Access level device 6. This cable will travel up the riser indicated in TR1.
3. If there is one TR on a floor, call it TR<floor number>. If there are multiple TRs on a floor add a letter suffix. For example, if floor 2 has 2 TRs, call them TR2a and TR2b. The same labelling method applies to TEs.

A final note regarding cable runs: For the purposes of this project, assume you will not be using consolidation points (CPs). While they can be useful, this project should not require them.

Legend

Create an additional page on your physical topology diagram for a legend.

Use the example plan posted to the course page as a reference. Make sure you only include elements on the legend that you are actually using, and if your group is using elements that are not shown on the examples ensure they are added to your legend.

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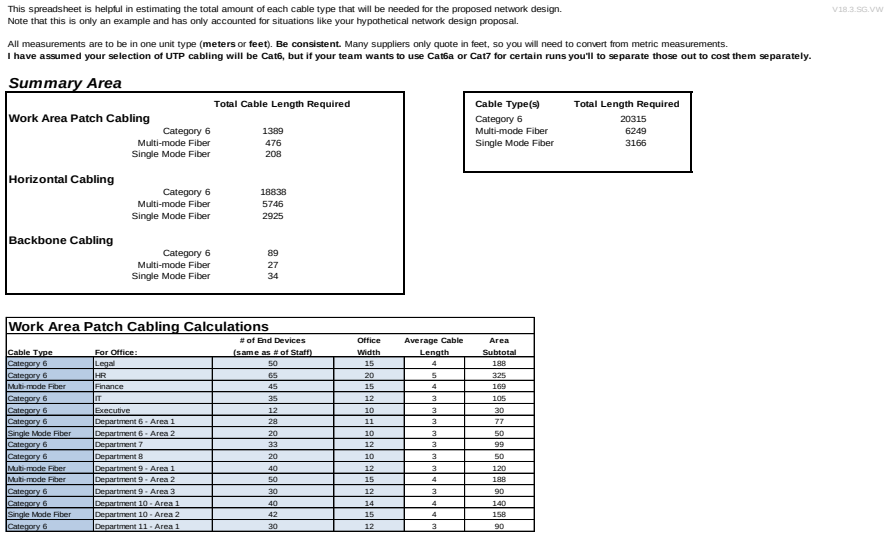
Costing your Proposal

Your group will need to calculating the total length of backbone, horizontal and work area cabling that your design requires. Yes, even though we're not drawing the work area cabling, you will need to determine and document what it will cost.

Your proposal's cost estimates will include not only the cable costs, but also the cost of all the network infrastructure devices you have specified. You will need to look online for these costs. You should be using new equipment, sourced from a reputable vendor. You will include the vendor name in your final proposal document.

To assist you in calculating reasonable cable lengths for costing purposes your team will want to use the CablingAssistant.xlsx spreadsheet tool. Enter the values appropriate to the design your team has created, use the resulting lengths when pricing out your cabling and be prepared to faint when you see the total. No kidding.



This spreadsheet is helpful in estimating the total amount of each cable type that will be needed for the proposed network design.
Note that this is only an example and has only accounted for situations like your hypothetical network design proposal.

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All measurements are to be in one unit type (**meters** or **feet**). **Be consistent.** Many suppliers only quote in feet, so you will need to convert from metric measurements.
I have assumed your selection of UTP cabling will be Cat6, but if your team wants to use Cat6a or Cat7 for certain runs you'll to separate those out to cost them separately.

Summary Area

	Total Cable Length Required
Work Area Patch Cabling	
Category 6	1389
Multi-mode Fiber	476
Single Mode Fiber	208
Horizontal Cabling	
Category 6	18838
Multi-mode Fiber	5746
Single Mode Fiber	2925
Backbone Cabling	
Category 6	89
Multi-mode Fiber	27
Single Mode Fiber	34

Cable Type(s)	Total Length Required
Category 6	20315
Multi-mode Fiber	6249
Single Mode Fiber	3166

Work Area Patch Cabling Calculations

Cable Type	For Office:	# of End Devices (same as # of Staff)	Office Width	Average Cable Length	Area Subtotal
Category 6	Legal	50	15	4	188
Category 6	HR	65	20	5	325
Multi-mode Fiber	Finance	45	15	4	169
Category 6	IT	35	12	3	105
Category 6	Executive	12	10	3	30
Category 6	Department 6 - Area 1	28	11	3	77
Single Mode Fiber	Department 6 - Area 2	20	10	3	50
Category 6	Department 7	33	12	3	99
Category 6	Department 8	20	10	3	50
Multi-mode Fiber	Department 9 - Area 1	40	12	3	120
Multi-mode Fiber	Department 9 - Area 2	50	15	4	188
Category 6	Department 9 - Area 3	30	12	3	90
Category 6	Department 10 - Area 1	40	14	4	140
Single Mode Fiber	Department 10 - Area 2	42	15	4	158
Category 6	Department 11 - Area 1	30	12	3	90

Using the CostingAssistant.xlsx spreadsheet tool, enter the information specific to the design your team has produced. The spreadsheet is self-explanatory.

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Instructions: **This spreadsheet will help you cost out your proposed network. Fill in the blue boxes and the sheet will calculate the one-time and recurring costs as per your specification.**

Taxes Automatically Added To These Columns

Item	Quantity	Purchase Cost (each)	Monthly Costs	Annual Support Costs (each)	Acquisition Cost	Total Yearly Costs	Supplier	Notes
Internet Connection	1	$ 2,500.00	$ 200.00	$ -	$ 2,825.00	$ 2,712.00	Rogers Business Internet	Includes termination hardware and five static IP external addresses
Core Network Thing	1	$ 35,000.00		$ 3,500.00	$ 39,550.00	$ 3,955.00	Cisco	Management card and sufficent ports included
Distribution Network Thing	2	$ 23,400.00		$ 2,340.00	$ 52,884.00	$ 5,288.40	Cisco	Stackable (expandable) unit
Access Network Thing	21	$ 8,564.18		$ 856.42	$ 203,227.88	$ 20,322.79	Cisco	Includes enough ports for all users etc., some expansion room, two spare units
110 Termination blocks	16	$ 61.00		$ -	$ 1,102.88	$ -	Awesome Network Supplies	Should supply enough pairs
Riser UTP cable (per metre)	2500	$ 0.75		$ -	$ 2,118.75	$ -	Awesome Network Supplies	Yada
Other cable (per meter)	3500	$ 0.77		$ -	$ 3,037.44	$ -	Awesome Network Supplies	Yada
Another cable (per meter)	42240	$ 0.56		$ -	$ 26,729.47	$ -	Awesome Network Supplies	Yada
You				$ -	$ -	$ -	HP	Yada
Put				$ -	$ -	$ -	Avocet	Yada
Your				$ -	$ -	$ -	Supra	Yada
Items				$ -	$ -	$ -	Infiniti	Yada
Here				$ -	$ -	$ -	Dupra	Yada
				$ -	$ -	$ -		
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Total Acquisition Costs: **$ 331,475.43**
Total Yearly Costs: **$ 32,278.19**

COMP 10019 – Network Design Proposal Assignment

Work Breakdown and Approximate Time Requirements

The process of creating your proposal can be broken down into five main parts. First, you should begin by reading the description of your assigned business and considering the office layout. Next, plan out a logical network design – that is, think of how many routers, switches, etc. are needed, think of where you will locate the equipment room ("data centre"), and so on – and create a logical network drawing. Third, add the components and cabling infrastructure to your office layout drawing (use this to ensure the length of your various cable runs are within the limits of the standard), and research and document the cost of the various elements you are adding to your physical design. The cabling and infrastructure device choices (and cost) should be documented early so that you can include those details in your "video call." Fourth, referring to the template provided, write a proposal that *documents your proposed network design and how it will address the network access and performance requirements of the business* – don't forget to add your drawings as required. Finally, create a video presentation that summarizes your design proposal.

Let's dive into these steps and review what's required:

Part 1 – Study the Office Layout **Approximate Time Required: 0.5 weeks**

- Read the written description for the business that has been assigned to your group. This is the case study document that has been uploaded to your group's files area.
- Note the various company departments and the number of employees per department.
- Examine the floorplans and identify the locations of potential TRs and for each department.
- FIRST SUBMISSION: Intent to respond letter.

Part 2 – Logical Design **Approximate Time Required: 1 week**

- Plan a suitable network using a 3-layer design with at least 1 core device and 2-3 distribution devices, as well as a suitable number of access devices (you'll want a minimum of 1 per department).
- Add these elements to a logical network diagram.
- Plan to put all servers in a "data centre".
- Identify a location for the ER and EF.
- Organize each department's access devices such that the traffic through them is approximately balanced.
- Make sure to consult the examples provided to see what we're looking for.
- Bonus mark option: Add an "optional" section to your design for an enterprise WLAN.
- Bonus mark option: Assign suitable subnets (or, if you're feeling adventurous, VLANs) for each department.

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Part 3 – Physical Design & Costing Approximate Time Required: 1.5 weeks

- Using the office layout drawing as a base, correctly add in structured cable elements:
  - EF, TR, TE, ER (again, you may want to consider locating your ER in an external, modular data centre).
  - Correctly add risers and conduit where needed.
- Show and label backbone cabling.
- Calculate cable lengths required for:
  - Backbone cabling
  - Horizontal cabling
  - Work Area cable runs
- Select and cost the appropriate cable for these elements.
- Be sure to consult the example diagrams we have provided.
- Spreadsheet templates with formulas have also been provided.
- If you decided to work for the WLAN bonus, your physical design and costing spreadsheet must include those components (be aware that this is a significant amount of additional work, so plan accordingly).
- SECOND SUBMISSION: "Video Call" video.

Part 4 – Finalizing your Proposal Approximate Time Required: 1.5-2 weeks

- Assemble the various parts you have already created into a final "network design proposal" document.
- Create an introduction to your document and preface your design information with a brief explanation of your design decisions.
- Ensure your proposal contains all the required elements; a template has been provided to guide you in creating your final document.
- THIRD SUBMISSION: Upload your document to the Network Design Proposal Document dropbox as soon as it's done (and before the deadline!).

Part 5 – Present your Proposal Approximate Time Required: 0.5-1 weeks

- Create a video summarizing your network design proposal.
- The video should be between 5 and 10 minutes in length; marks will be deducted for videos longer than 10 minutes and shorter than 5 minutes.
- Ensure that your video:
  - Introduces your group.
  - Briefly summarizes the information you received about the company you created your design for.
  - Shows what components and infrastructure you have specified for your design and, importantly, why you selected those elements.
  - Is professional, but creative!
- FOURTH SUBMISSION: Upload your presentation video to the Network Design Proposal Presentation dropbox as soon as it's done (and before the deadline!).

Final Steps

When someone from your group has uploaded your design proposal document and video, your team is done! Congratulations!

Pro tip: Every time your team uploads a submission have someone else from the team download it from the dropbox to confirm that it is the correct item and version. Discovering this *after* the deadline will not work out well for you and your team…

Your final important task is to use the online "Network Design Proposal Peer Evaluation" form. When you fill it in you must ensure that you comment on all of your group members including yourself. **This is a solo activity, and all members of the group must complete and submit their own copy of the online form by the last day of the course.**