Computer Systems Infrastructure and Management

600099

Network Infrastructure

Configuration Report

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# Problem Breakdown

The task involves the development of a network infrastructure for the University as part of their new building expansion. The main point of interest for the expansion is to incorporate a relevant and efficient network topology that aims to serve and connect the Engineering and Computer Science departments, by providing expansion upon their already existing building.

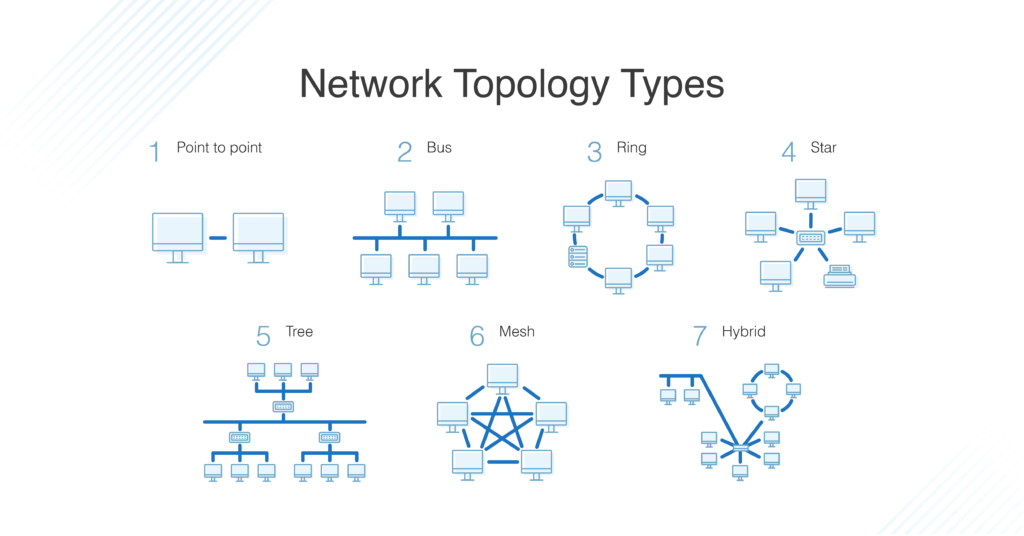
The university spans over 2 floors. There is need to develop a network solution that allows a connection across the different departments, where Computer Science and Engineering share spaces amongst the building. A network needs to be developed and plotted that aims to suit the requirements of the building as well as meeting the requirements of both departments. This will be achieved through a suitable, relevant and efficient network topology that allows the requirements to be met. The network topology chosen must meet the requirements of the internal structure. An example of some topologies that are available to be used for this can be found in figure 1.

Figure – Available Network Topologies

For this, consideration needs to be taken for the density of the pooled spaces, capacity of offices and the potential for wireless connectivity, which will allow expansion across the entire space. The two departments require their networks to be separate but to also be able to connect and share resources with each other across the pooled space. This connection needs to be available not only for local computers, but where necessary this must also cover the needs of those who use their own devices in the workspaces available or across the campus local area network.

The network infrastructure solution must allow for the ability to support activities within the computer labs, even when these labs are at capacity. This means that a fast connection needs to be available and that maximum through-put needs to be considered, but the likelihood that the full potential of network bandwidth will be used is not high. Mitigation to allow for this should be in place, to allow for no issues in lab use where capacity is expected to be higher than normal, especially in times of deadlines for coursework submissions. Due to the location of the comms room, a high speed wired connection needs to be available throughout the building that can suitably provide power and connection across the entire space.

The comms room can be found towards the south side of the building and consists of a long spanning corridor with only one entry and exit point along an outer wall. The corridors span the length of the floors and allow for ample ability to get everywhere, with no visible issues that can be seen from the floor plans regarding navigation.

To meet the requirements, the proposal is for a three-tiered network topology to allow for easy connection through the building, alongside allowing for future building expansions if these are deemed necessary later down the line. The corridors allow for Access Points to be situated in corners so that their connection can travel effectively through spaces without much interference or issues with walls effective connection quality.

The aim is to theoretically deploy the chosen topology to discover what resources will be needed and to gauge expected costs for this expansion. This includes the wiring, devices and additional network equipment that might be needed. Not all spaces within the building are expected to require a physical connection, but the building should have a wireless solution available throughout which is something to cover near the end of the report.

Requirements.

* Network should be suitable
* Support activities within the building through the different labs and office spaces
* Collaborative spaces should have access to shared resources
* Department resources only accessible to those who require it unless within a shared space, where access to a shared space will be more ideal
* Networking equipment needs to be cost effective and allow for future expansion
* Wireless solution needs to be considered and added
* 3-layer structure the best solution, with core, dist and access layers across
* Server equipment is appropriate for the topology solution

# Solution Proposal

## Network Topology Structure

The topology decided on for the implementation of the theoretical deployment here is the **Three Tier Hierarchical Network Topology**. This topology consists of 3 layers which are the Core layer, Distribution layer and Access layer.

***TODO change to discuss router in the core layer instead of ML Switch***

### Core Layer

The Core layer is the topmost part of the topology that connects to the external firewall, and normally will consist of expensive routers. This part of the topology is the backbone of the network and allows for connection to the Wide Area Network (internet access). The core layer needs to be designed with high availability and reliability in mind, and a fault tolerant design needs to be considered as well. Any failures need to be sure to have a minimal impact on the network and its connectivity.

To connect the Core layer for this network, it is proposed to use a multi-layer switch, which is a device that can perform the functions of a switch as well as a router at fast speeds. This network device can operate at higher layers within the OSI model, rather than being limited to the Data Link layer at layer level 2. This device can route packets and look inside these packets to make sure they are routed to the correct destination.

The choice between a router or a multi-layer switch here comes down to business need. Normally a router is the best choice for the Core layer implementation and connection, but in this case the proposal of a multi-layer switch feels more ideal, as it allows for more ports to be accessible to the Distribution layer, alongside better network performance and VLAN segmentation.

One of the main requirements of the network is to allow for the ability to have the departments operating on their own inter-networks, but also allowing for resources to be accessible in shared spaces such as the labs and for wireless devices being used within the building or Local Area Network on campus. To allow for the ability to fulfil this requirement for shared resources within the network, alongside separate local networks for departments, the Core layer multi-layer switch will connect to two multi-layer switches found in the Distribution layer.

### Distribution Layer

The Distribution layer is the layer that is located between the Core layer and Access layer in a three-tier network. The purpose of this layer is to provide a boundary definition by implementing access lists. This layer defines the policy for the network and ensures that packets are delivered to the correct end devices. This is done through inter-VLAN routing.

Two multi-layer switches will be located within the Distribution layer, with each of these connecting to each switch in the access layer. To set up the network so packets go to the correct place and so that the departments can remain separate whilst being on the same physical network, Virtual Local Area Networks (VLANs) can be used. This solution is used, as it is possible to have the departments on the same physical network, whilst separating them into multiple logical portions that act as individual networks.

The amount of VLANs needed for this solution is three. There will be a VLAN set up for each department, and a VLAN for the shared resources for the pooled areas. The multi-layer switches in the Distribution layer will enable connection to the department servers VLAN, as well as a connection to each departments access switch, which will be located within the Access Layer. This is done to make sure that access to department services and resources are only possible when required, and that packets are routed to their correct destination, with no possibility for these packets to be seen outside of the destination VLAN.

### Inter-VLAN Routing

The technique of Inter-VLAN routing is effective to route traffic to each VLAN on the network so that packets get to their intended destinations and are not visible to the other VLANs present on the network. The multi-layer switch allows for the ability to achieve switching and routing in a single box. This technique can be achieved in three different ways, but for this network, the use of inter-VLAN routing through a multi-layer switch is the chosen solution.

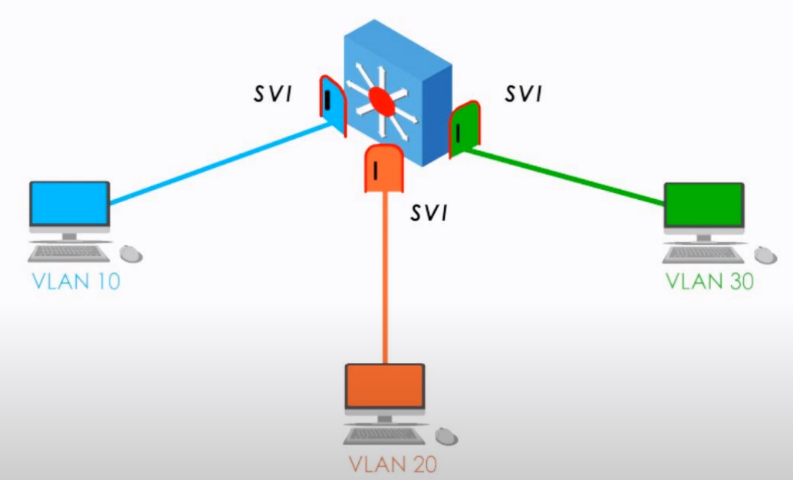
This is considered the best option as the multi-layer switch has the capabilities of a switch and router within a single box and makes use of switch virtual interfaces to act as gateways and perform routing.

Figure 2 - Inter-VLAN Routing

The Switch Virtual Interface is important as it represents the interface on the L3 switch. This interface is important as it is needed to communicate with hosts in another VLAN. For this use case, the SVI will be configured to allow for traffic to be routed to the correct VLAN it is intended for, by providing a default gateway for each VLAN.

Trunking / Tagging is also something necessary to allow interconnection between switches. The switches are interconnected to establish these networks through trunking. These switches will have access ports alongside trunk ports, to allow the switches to share VLAN access and information between each other. This is also a good way to avoid problems later, where if one switch goes offline, the other switch can maintain the network until the problems are resolved.

### Access Layer

## Comms Room

## Cabling

## Network Equipment

## Access Points

## Wireless Implementation

CHOSEN SOLUTION – Task List

* 3 VLAN with access to shared resources multi-layer switch
* Inter-VLAN routing and traffic
* Cabling will be Ethernet PoE Category 6 (research more power over ethernet cables)
* Adjust logical topology diagram – done so far
* Consider physical topology diagram, probably not needed though
* Decide upon all required equipment
* Start to look at prices, shop around, find lowest prices, maybe in bundles as well
* No servers / compute resources necessary
* Consider through-put heuristics of the labs, they don’t need higher data rate of 1Gbps max
* Network equipment (switches, routers, multi-layer switch can achieve a combined effort)
* Switches require some sort of link aggregation / degradation support, consider this)
* Consider number of needed ports, attenuation, link aggregation, etc
* What about any additional equipment?
* How would this equipment be configured? Wifi coverage etc
* Remember to justify all choices in the report
* Consider costs, try and save, cost should be reasonable, if something is cheaper, why this equipment over that?
* Consider expansion possibilities later
* Research Backhaul (2.4Ghz & 5 Ghz speeds and sharing / split)
* Consider aspects of Wireless integration across a Campus LAN
* Dual band APs at a minimum
* Equipment for Comms Room

# Bibliography

**There are no sources in the current document.**

<https://www.cisco.com/c/en/us/support/docs/lan-switching/inter-vlan-routing/41260-189.html>