University of Hertfordshire
School of Computer Science
BSc Computer Science / IT

Module: Network Protocols and Architectures

Network Design

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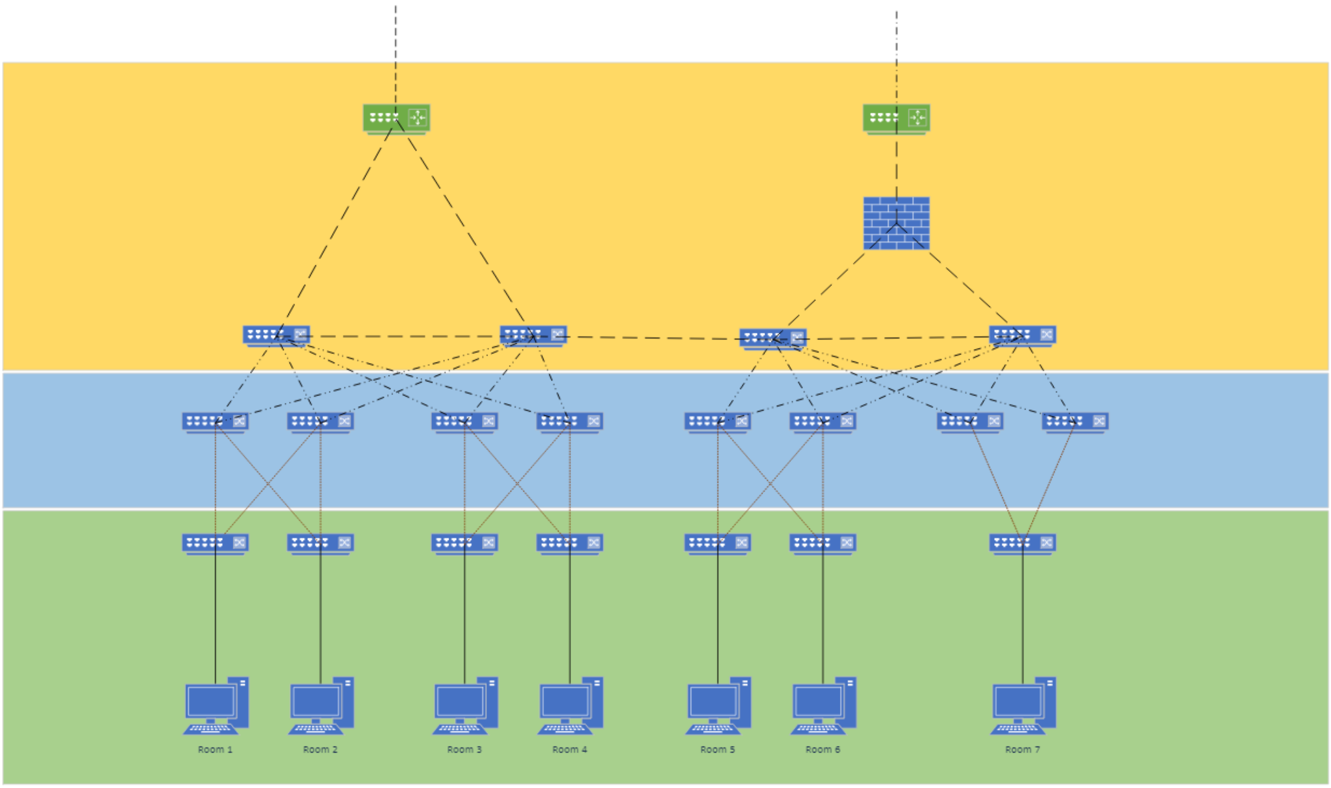
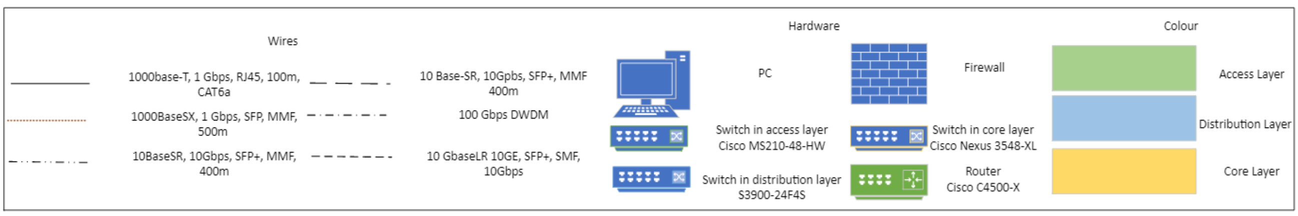
Chapter 1. LAN (Local Area Network)

Section 1.1: LAN Logical Diagram

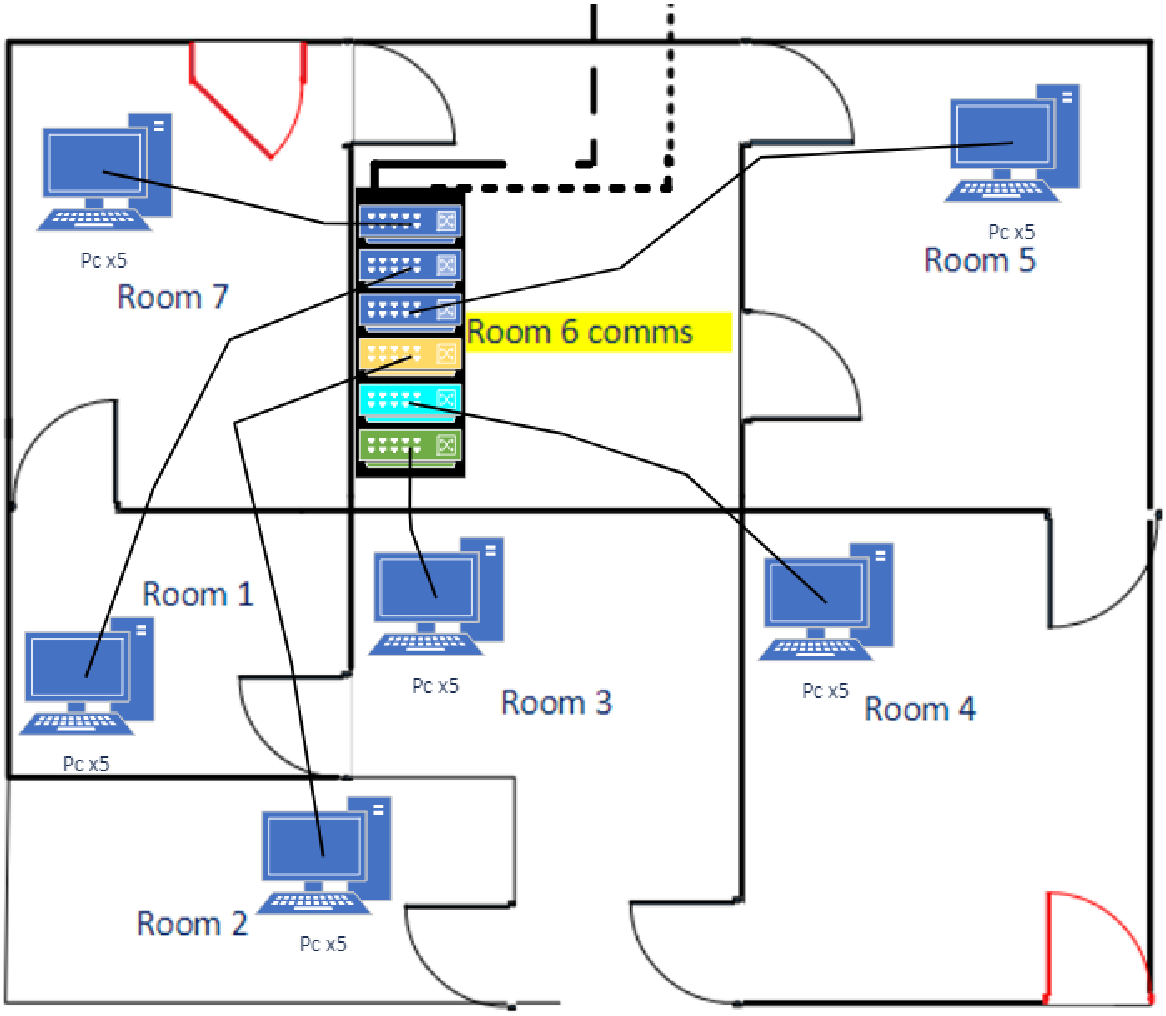


Section 1.2: Logical Legend

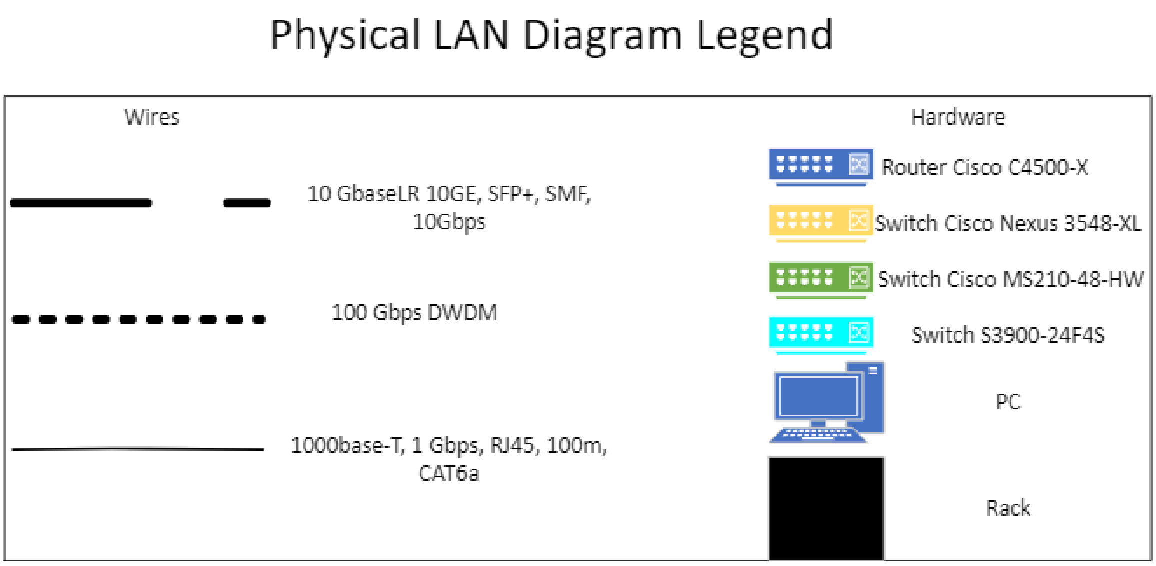
Logical LAN Diagram Legend



Section 1.3: LAN Physical Diagram



Section 1.4: Physical Legend



Section 2.1: Design Description

The Cisco Hierarchy Model was the primary basis for my LAN (Local Area Network) design. This design has a separation of the three layers: the access layer, the distribution layer and finally the core layer. The reason to why this model is helpful is because it can: organize large networks into small networks, manageable sections, creates reliability, scalable and finally it is cost effective for complex systems (Geeks for Geeks, 2022). Communication devices such as: firewalls, switches and routers were placed in a rack that was allocated to room six as per the specifications request. In room six the switches in the rack were connected to the PCs in each room through cables inserted in the wall.

Section 2.2: Redundancy

When the design of the LAN was taking place, the key was to make sure that the network was fully redundant even if there is a case of failure. In this case the access layer switch is connected to two different distribution layer switches. This is because if there is a failure in the switches in the distribution layer communication can still take place. Even if there is a failure in the core section the distribution switches are connected to two different core switches. The anti-disruption of traffic was the key reasoning for these measures of a failure in any section within the network.

Section 2.3: Scalability

In the access layer of this network there is still the ability to add an additional 10 PCs in every room. If a switch with only 5 or 8 ports was installed new switches would be needed for each room which would lead to the network not being scalable thus this approach was not suitable in this case. To accommodate the idea of new networks with minimal or no impact to the network traffic, in the distribution and core layer switches with 24 to 48 ports was selected. Due to all this scalability is created in this network.

Section 2.4: Cabling

To abide by the specification provided for the network, this diagram for the network has a range of cables. To avoid any issues within the network such as “bottleneck” the cables in the network were carefully selected and ensure an optimised network.

Firstly, in the core layer the 10Base-SR, 10Gbps, SFP+, MMF, 400m cables was used for the connections between the routers and firewalls. The SFP+ cables use modules of LC connectors to establish a connection between switches (Warshal, 2019). The reason as to why this cable was used is because the specification requirement stated the need for the cable to handle 10 Gbps with the routers. Due to the long distance connection from the club offices to the main premises the specification templated the use of 10Base-LR, 10Gbps, SFP+, 25Km, SMF to be connected to the routers.

Additionally in the core layer, the 10Base-SR, 10Gbps, SFP+, MMF, 400m cables were also used in the connection between the switches in the distribution layer and the switches in the core layer. As stated before, these SFP+ cables use modules of LC connectors to establish a connection between switches. These cables also transfer data at the speed of 10 Gbps.

For the distribution layer, the 1000BaseSX, 1Gbps, SFP, MMF, 500m cable was used to connect the switches in the access layer and the switches in the distribution layer. These cables can transfer data at 1 Gbps over a fibre optic cable. Within the rack fibre optic won't allow crosstalk with the other networks.

Finally in the access layer, the cables used were 1000baseT, 1Gbps, RJ-45, 100m CAT-6 cables between the PCs and the switches in the access layer. To also support the transfer speed of 1 Gbps this copper cable was used which is compatible with the desktop PCs.

Section 3: Network Hardware

Section 3.1: Cisco C4500-X Router (Router)

Firstly, for the purpose of scalability this router was chosen because if expansion is required this router would be able to facilitate that. Also, the port in the router which is a 32 10GbE SFP+ can accommodate the connection of the 10Base-LR from the premisses which is the main connection. Fibre cables of 20Base-SR SFP+ can also connect to this router form the switches in the core (University of Oregon, 2019).

Section 3.2: Cisco Nexus 3548-XL Switch (Core layer)

For the purposes of compatibility this switch was selected. This is because of the 48 10GbE SFP+ port which will host numerous things such as the connection between the firewall, routers and switches which will be SFP+ and from the distribution layer the cable of 10Base-SR SFP+ would be supported. This procedure will not allow mismatching hardware which could cause bottleneck issue (Cisco, 2021).

Section 3.3: FS S3900-24F4S Switch (Distribution layer)

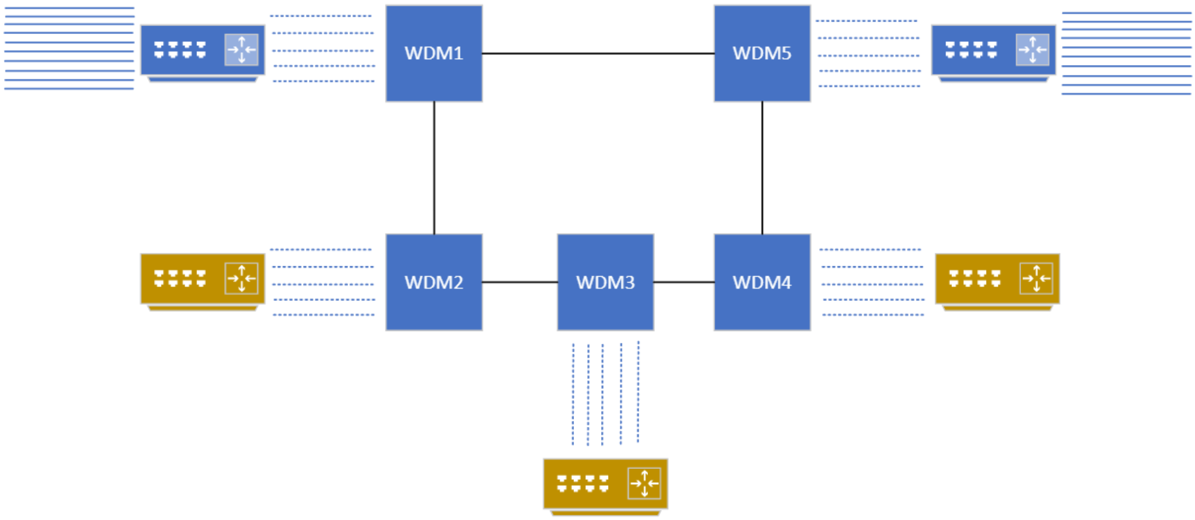
The cables coming from the access port are the 1000BaseSX SFP cables and the cables going to the core layer are the 10Base-SR SFP+ cables. This switch has a 20 1GbE SFP port that can accommodate for the access port cables and has a 4 10GbE SFP+ port to accommodate the cables going to the core layer. Thus, this switch was the best to use (FS, 2017).

Section 3.4: Cisco MS210-HW Switch (Access layer)

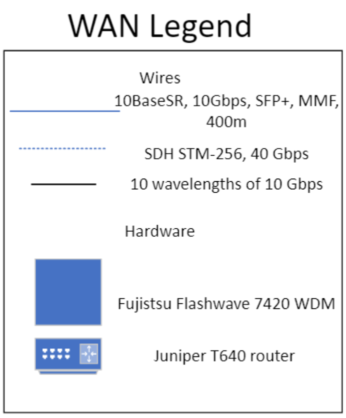
As stated before, this switch has 24 ports in case more PCs are wanted to be added. Also, RJ45 cables can be used in the PCs as this switch is able to support this cable. Foe connection between the distribution layer the cables that will be used is the 1000BaseSX SFP cables and this switch has four 1GbE SFP ports to take advantage of (Cisco Meraki, 2020).

Chapter 2: WAN (Wide Area Network)

Section 4.1: WAN physical diagram



Section 4.2: WAN legend



Section 5.1: Design Description

The model of this design depicts the model given in the specification of the WAN design. The specification comprehends five cities within the WAN model which is included above.

Section 5.2: Redundancy

Other networks are still able to communicate even if one cities network d=goes down. Neither of the cities will be affected if the network does go down.

Section 5.3: Scalability

The hardware used in this network have enough room and can handle an expansion with ease. The WDM device is mandatory according to the specification but can manage a lot more speed than used in this network. Also, the router used can manage an addition on ten more connections as it has a total of thirty-two ports. With all this combined this network is scalable if needed.

Section 5.4: Cabling

The connection between each city will be held with the WDM device. This will be done by splitting 10 wavelengths of the 100 Gbps fibre connections which will be known as WDM channels. Each acting as its own channel carrying 10Gbps.

With regards to the router connections, the main connections will be the ten 10BaseSR, 10GbE, SFP+, MMF, 400m cables. 100 Gbps will be accumulated in these ten connections, and this will be between the main premises of WDM5 stated in the diagram and the LAN connection of the offices this is all specified in the specification. The WDM will be using 40 Gbps connections from the router using five SDH/STM-256. To prevent a "bottleneck" situation the cables used are capable of 40 Gbps and are each being used at 20 Gbps. The four cables used will equivalate to 100 Gbps as an incoming connection.

Section 6: Network Hardware

Section 6.1: Fujistsu Flashwave 7420 WDM platform (WDM)

SDH/STM-256 connections are supported by this WDM platform which will be needed when connecting to the routers. For this network ten wavelength channels will be used at a speed of 10 Gbps and this will be easy for the WDM as it is designed to withstand from 40 to 80 channels at a fixed optical add/drop multiplexer. This in simple terms means that the ten channels will be easy for this WDM and will not struggle at all. Thus, this WDM platform is the best for this network. ("FLASHWAVE 9500 - Fujitsu Global")

Section 6.2: Juniper T640 (Router)

Finally, 100 Gbps WDM connections detailed int the specification is needed from the router and this router can manage speeds of 640 Gbps. 10 GbE ports and found 32 times and only 10 of these will be used from the router. For the five SDH/STM-256 connections coming from the WDM platform this router supports SONET/SDH and eight STM-256 ports. Thus, this router is the best to use for this network (Juniper Networks, 2009)

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