

Proposal

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**An investigation into the
effects of various network redundancy
protocols on the performance of a
campus style network.**

Research proposal

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BSC Computing (Computer Networks and Cybersecurity)

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Introduction

When it comes to transmitting data in an environment where reliability and security is key like an educational environment it is vital to ensure that any networking solution implemented has minimal impact to the experience of its users, therefore in this independent research project, I will aim to answer the question, 'to what extent do different network redundancy protocols effect performance on a campus style computer network'. I have chosen this topic as I believe that in the modern landscape of computer networks it is important to identify key bottlenecks in network performance due to the ever-increasing demand for bandwidth, stability and security on modern interconnected networks and the ever-increasing threats and risks posed by internal and external factors. I am further motivated to pursue this research as it tightly aligned with program of study 'Computer Networks and Cybersecurity' with network redundancy playing a key role in all aspect's aspect of the CIA triad information security principles [1].

To this extent I have identified a gap in the current research surrounding this area of study. In a recent analysis of different redundancy protocols and their effects on network response time and packet loss [2] . The scope of the research conducted was narrow as it only investigated impact of a limited number of routing protocols, I believe that there is a gap that could be filled in this research by expanding on the research by also considering redundancy at the switching layer of the network.

Background to the Proposed Research

In the field computer networking the goal is to provide a network that can deliver on the functions required by the user, this is especially true in an educational environment where the availability of the data and resources provided by the network are of increasing importance and the network must maintain its availability at all times [3]. Therefore, it is vital that the network be developed and designed with an array of different redundancy measures that will provide the network with stability during an outage. This is becoming increasingly necessary due to the ever-present threat of cyber-attacks and other malicious actors aiming to do damage to large networks, this is a fact highlighted in the 2025 UK government cybersecurity breaches survey that shows 43% of all UK businesses will suffer some form of cyber related attack [4] this research also shows 15% of large UK institutions have suffered the type of attack that can cause service outages, this being the DDOS (Denial of service) attack which aims to reduce the availability of network resources [5]. To combat the risks of outage methods will need to be implemented to combat this, the main way of doing this is the implementation of a redundant topography, as can be seen in the International Journal of Advanced Networking and Applications, vol. 16 [6], this will then be followed up with the implementation of the protocols to facilitate the use of this reinforced design, there are many types of protocol that can be to provide this service in differing ways all of which work in differing ways that have benefits and trade-offs when compared to each other, as can be seen in many research papers [2. 2. 7. 2. 7. 8] .

As previously stated, I have identified a gap in the current research which relates to these redundancy protocols and the effects they have on network performance. Previous literature on this topic such as a redundancy protocol analysis by Mohamed Hamied [2] and again previously in a 2019 IEEE conference [7] and again in a report on the a report on gateway redundancy protocols [9], all of this literature only assess the impact of protocols that operate on layer 3 devices and such as the VRRP [10] and the HSRP [11] protocols and their various effects on the network, and does not take into account what difference the addition of layer 2 redundancy protocols may have on the overall performance of the network. Likewise, research has also been done on the effects layer 2 protocols and the effects on performance as can be seen in a report from the 2024 UHD Journal of science and technology, which compares the SPT and RSTP protocols [8] however, again this has not been done in conjunction with layer 3 protocols and the results analysed. Therefore, I believe there is a gap that can be filled by taking the abovementioned research and combining the methods and collecting new data to provide a more comprehensive view of the impact all these protocols have on performance.

Research problem statement

This project aims to solve the problem of there being a lack of research on the combined effects of different computer network redundancy protocols of both layer 2 and 3, on the overall performance of a campus style network. And how this compares to previously conducted research on the effects of the individual layer protocols.

Research aims and objectives

Aim: The aim of this project is to assess to what extent the combination of both layer 2 and layer 3 redundancy protocols effect overall network performance, using statistical and numerical analysis.

Objectives:

- To design develop a suitable network topology that can be used to test, compare and implement redundancy protocols, in both a physical and simulation environment.
- To analyse the effects of the network redundancy protocols on the performance of the network and its reliability.
- To compare the data gathered from this research with that of previous research to determine if the combination of both layer 2 and 3 protocols has a marked effect compared to that of the previous single layer analysis.

Deliverables

By the end of this project, I aim to be able to deliver a detailed statistical analysis and report on the effects of layer 2 and 3 protocols on the performance of a computer network with data collected from both simulations and real-world hardware.

Methodology

Methods

When It comes to the research method that will be used for collecting data and results for this project I will be using a quantitative approach, this is due to the fact that the outcomes that I will be analysing will be exclusively based on numerical data that will be collected from rigorous experiment based research which will be used output multiple sets of precise numerical data that will be used to conduct a statistical analysis to determine the outcome of the experiments.

For all the experiments and test conducted for this project a robust network design will be implemented and will act as a baseline and constant for all the experiments as the physical network layout falls outside of the scope of the research. This topology will be designed to a scale that is suitable for a campus style network environment and will feature a collection of redundant links so that the protocols can be tested in an ideal use case environment. An example of the type of network that I aim to develop can be found bellow in figure 1, which is taken from previous research on campus network design [6]

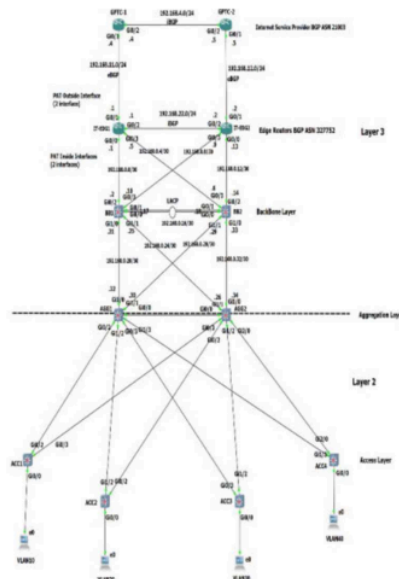


Figure 1 Network Topology [6]

Data analysis

When the data has been collected, as previously mentioned I will use a variety of statistical techniques to analyse the collected data. This will take the form of calculation averages and data variance [Figure 2, 3] to ensure that data is reliable and to exclude outliers from my data set so that the data is accurate.

$$\bar{X} = \frac{\sum X}{N}$$

Figure 2 Mean Average

$$s^2 = \frac{\sum (X - \bar{X})^2}{N - 1}$$

Figure 3 Sample variance

Limitations

For this project I have identified very few risk / limitations / ethical issues, with the exception of the limitation on hardware that will be available to me to conduct the physical aspect of my investigation. However, this will depend on what shape the final topology will take when further investigation is conducted into the execution of the project.

Materials / resources

The vast majority of this project will be conducted via simulation; this will be done using the CISCO packet tracer software [12], this will be conducted on the university LAB hardware (IQ 205) and personal hardware. For the practical implementation I will require access to physical switching and routing hardware also available from the IQ 205 lab. For data collection I will use the inbuild ping and trace route features present in the cisco hardware and software as this is as close as possible to the source and will provide all the data I will need.

Project Plan

Task	Start date	End date
Further Research on redundant topology	20 th October 25	3rd November 25
Topology design and implementation in software	4th November 25	17 th November 25
Redundancy Protocol Implementation and testing	18 th November 25	8 th December 25
Initial data collection and analysis	9 th December 25	5 th January 26
Preparation for interim Viva	6 th January 26	14 th January 26
Physical implementation & data collection	19 th January 26	9 th February 26
Data & statistical analysis / time for reruns of data.	10 th February 26	2 nd March 26
Report writing and final analysis. And Final Viva preparation.	3 rd March 26	1 st May

References

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Proposal

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

75/100

PROJECT PROPOSAL – ACCA6020 INDEPENDENT PROJECT

Student Max
Beasley **Mark**
75 %

Intro / A&O (400 words)		
Project title; Identification of a specific problem to be investigated; Well-defined aims and SMART objectives; Explaining why this project is worth doing; Discussion of what the project needs to do in order to be a success; Description any deliverables that will be produced at the end of the project	20	17
A good project worth pursuing and properly justified. We will need to add one or two more objectives to ensure that everything being done in the project is captured, and we will also need to explicitly mention the actual developed network as a deliverable.		

Background to the Project / Literature Review (400 words)		
Description of how the work to be done by in the project relates to the work identified in the literature review; Discussion of any ethical issues raised by the project Identifying what has already been done within the field; Topic familiarity; Brief literature review using appropriate sources – 6-8 journal papers and book chapters rather than just websites; Selection of relevant models & concepts There is a clear relationship between the work to be done and the work identified in the literature covered in your Introduction and Background to Proposed Research sections. You could have scored more marks if you had included a separate Literature Review section; however, your references are of good quality. It is also clear that your project does not have significant ethical issues. It is a good thing that you included a sample network topology, which is relevant to your study.	20	16
Project Design (500 words)		
Clear statement of which development methods are to be used and why they are appropriate; Clear statement of which tools are to be used and why they are appropriate; Clear	30	19

description of how data collected will be analysed This is the area that has room for improvement. There is a need to consider whether this project will be more developmental or experimental. Since most of the work will be conducted in Packet Tracer, it may be challenging to obtain valid data for accurate analysis. Taking a developmental approach might be a good idea.		
Resources / Planning (200 words)		
List of any deliverables; Clear diagram showing both timing and resource use; Completed ethics form; Limited and relevant appendices You completed the ethics form, and by the nature of your project, there are not many ethical issues. The actual developed network should be mentioned as a deliverable. You have a project plan, but you may need to review the duration of the tasks to ensure they are realistic. You could also have represented your project plan in some form of a chart.	15	11

Document Presentation		
Correct spelling, grammar and punctuation; Flow of narrative/fluency; Coherence; Word processed ; Correct use of referencing with bibliography; Strict word limit Despite a few spelling and grammar mistakes, you managed to adhere to the word limits, and your referencing is good, as is the overall format of the document.	15	12
TOTAL	100	75

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