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| **CMPG 315: GROUP PROJECT** | |
| **Group members:**  Zané Kennard - 40898989  Franco Burger – 24904635  Jason Coetzee – 40821749  André du Raan – 35476087  Stephan Schmidt – 35459980  Ruan van Heerden – 41763882  Renier van Rooyen – 43151906  Johan-Louis Coetzee – 40887340  Conrad Nicolas Du Toit – 34386084  Lohard Janse van Rensburg – 37248529 |  |

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| Overview Our group was approached by a company seeking to expand their business. The company decided to move to a newly built office building, that does not have any suitable network infrastructure apart from a business ISP fiber connection and ONT. They have given us the task of setting up the new office network in the new building. A large number of computers and office equipment has already been purchased by the company, and their finances do not currently allow for extravagant expenses. With these limited finances our group must design the network in such a way that the costs are kept to a minimum, and still satisfies all the requirements set forth by the company. The company wants the network to be capable of supporting all the computer equipment they purchased as part of the expansion, as well as the equipment that they are moving from the old office.  In addition to setting up the network, the company has instructed our group to develop a small, simple, text messaging app that can be used for non-confidential communication inside the organization. The messaging app must run on Windows, and it has to work over the Internet, it should also be fully portable, so that it can easily be used by employees working from home and abroad.  Following are few potential problems that our group will need to address:   * Each staff member should be able to connect 1 – 4 WiFi devices to the network.   These devices should be treated as untrustworthy.   * All network devices should be able to access the internet. * Each device that connects with a wired access point should be capable of 50Mb/s synchronously. * The devices that connect with WiFi should be capable of 10Mb/s synchronously. * remote software should be implemented. * Security implications. * Bring Your Own Device considerations. * Establishment of a cooperative virtual workspace. |

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| Network Topology Our network topology aims to satisfy all constraints as follows:  Different sections of the building (Office, technician's office, etc) are each assigned to a separate VLAN for all contained devices, with their main gateway being a central L3 switch in the Machine Room, through which all traffic passes. This switch also provides the DHCP services, with appropriately assigned ranges and exclusions for each VLAN. The VLANs are then isolated as well, using access lists applied to their interfaces on this central gateway switch.  Using this principle, we provide wired access points to each room, with each room having at least one switch linked to the central gateway through another bridging L3 switch (there are 3 in total L3 switches in the machine room, with one being the central gateway, and the others connecting different rooms to the main switch), also in the machine room. The number of switches in each room depends on the access point requirements and the amount of people that must be assigned to it. Switches are daisy-chained where appropriate in these rooms to achieve the required amount of access points.  Wifi is supplied to each isolated section in the building, with wireless routers strategically placed to cover the required number of connections. Each router can hold 30 devices maximum. Where indicated as necessary, wireless devices were added to represent a wireless connection. In places were indicated that “WiFi must be available”, an appropriate number of wireless routers with the sufficient device capacity for the room’s maximum capacity were placed.  A centrally placed server (linked to one of the 2 L3 bridge switches) is accessible to all vlans, except for the guest WiFi. This server is used to provide DNS services.  1 Router is connected to the main Gateway switch (to fulfil required bandwidth of approximately 12gbps when all devices synchronously access the internet it has 2 SFP+ 10Gbit fibre ports, which could not be shown on the packet tracer network as it does not have a router with the appropriate number of ports), all internet traffic passes through this router. The router’s interfaces are split up between each VLAN to ensure maximum throughput. **Link aggregation would be used in the real-world installation to achieve the bandwidth requirement.** It is connected to the main ISP device where our connection also terminates (a cloud in our simulated topology). |

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| VLAN assignment per room on gateway switch |

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| DHCP Setup on main (gateway) switch |

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| Access list setup on Gateway switch |

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| Setup Cost **Devices:**   * MikroTik Cloud Core 16 Port Gigabit 2SFP+ 4 Core Router | CCR2004-16G-2SFP+ – R10 534,00 @Takealot.co.za * Main 24 port Switch, *Cisco WS-C3650-24PS-S 24 Port Gigabit POE+ IP Base L3 Manage 1U Switch* - R2230,53 @ ebay.co.za * *TP-Link LiteWave 5 Port Gigabit Desktop Switch* - R229,00 @ takealot.co.za * *Tenda AC8 AC1900 Wireless Dual Band Gigabit Router* - R609,00 @ makro.co.za   **Cabling:**   * Cat5e LAN Network Cable - 50m @takealot.co.za * Cat5e LAN Network Cable - 22cm @takealot.co.za   **Labour costs for installation:**   * We require 3 Network Technicians working for approximately 36 hours each, over a course of 4 working days to fully install and test the network. * Utilising the average job listing price for South African Network Technicians on the popular job listing site Pnet.co.za, we approximate that each earns R70/hr for this job. * This then equates to **R7 560**.   **Wireless Access Software:**  SplashTop Remote Access software   * License: Business Access Pro. * **R3662,88** |

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| Cost table  |  |  |  |  | | --- | --- | --- | --- | | **Device/Service** | **Amount used** | **Cost per unit** | **Total cost** | | MikroTik Cloud Core Router | 1 | R 10 534 | R 10 543 | | Cisco 3650 24 port Switch | 3 | R 2 230.53 | R 6 691.59 | | Tp-Link 5 port gigabit Switch | 75 | R 229 | R 17 175 | | Tenda wireless Router | 12 | R 609 | R 7 308 | | Wireless Access software | 2 (Licenses per annum) | R 1 831.44 | R 3 662.88 | | Cabling (100m Cat5e) | 30 | R 129 | R 3 870 | | Cabling (22cm Cat5e) | 30 (Packs of 5) | R 159 | R 4 770 | | Labor Costs | 3 People | R 2 520 | R 7 560 | | **Total** |  |  | R 61571.47 |   **Contingency (20%):**   * With a contingency of 20%, an amount **R73 885.76** of will be budgeted. |

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| Remote Connectivity **Splashtop:** Splashtop is a family of remote-desktop software and remote support software, developed by Splashtop Inc. Splashtop enables users to remotely access or remotely support computers from desktop and mobile devices. It contains functions like:     * High-Frame rate: High frame rate of 4K streaming up to 60fps and iMac Pro Retina 5K streaming along with 4:4:4 colour mode, and high-fidelity audio enables an immersive remote access experience. * Broad device support: Stay connected on any device! Get unattended remote access to Windows, Mac, and Linux devices. Access from any Windows, Mac, iOS, Android, or Chromebook devices. Also access virtual machines and virtual desktop infrastructure (VDI) on VMware, Citrix, Microsoft, Windows, AWS, Azure, and others, all from the same application. * Secured managed access: Control who can access what. Team admins can manage computer access permissions directly from the Splashtop web console. Allow the entire team, specific roles, or individual users to access each computer. * File transfer: Easily transfer files between computers. You can transfer files without starting a remote session, and you can drag-and-drop or work in the file transfer window to move files between your local and remote computers during a session. * Remote Print: Work on a remote computer - and print to a local printer! Print from within your remote session and select the Splashtop Remote Printer driver to send the print job to a local printer. No need to transfer files or email a document to yourself. * There are more versions available at a higher cost which include functions like Multi-Monitor Support, Remote Reboot and Wake-on-LAN, High Fidelity Audio.   Splashtop includes advanced security features, standards and compliance, data, and session privacy. Splashtop solutions are built to give IT full control over securing remote access for today's distributed workforce. Security features include two-factor authentication, single-sign on integration, endpoint MFA, blank screen, idle session timeout, remote connection notification, full session audit logging, and more. All remote sessions are protected with TLS and 256-bit AES encryption. Splashtop is ISO/IEC 27001, SOC2, GDPR, and CCPA compliant. Splashtop solutions are designed to support organisations in meeting their HIPAA, FERPA, PCI, and other industry compliance requirements. Splashtop does not process, store, or have access to any of our users' computers or applications and data accessed during a remote session.  Splashtop not only offers robust cloud infrastructure hosted on AWS for secure networking and computing, but we also provide on-prem options for those who prefer or require local hosting solutions. Our commitment to security extends across all platforms, adopting industry best practices in development, deployment, and production environments with 24x7 intrusion detection and defence mechanisms enforced. |

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| Network Evaluation  * This network is able to fulfil all requirements through our testing. * It is relatively simple to set up (due to the majority of things being configured on the central machine room switches), which will reduce installation costs and time required to become operational. * We did not foresee any specific problems that might occur when using this setup, however the price might be a negative factor if the company is on a strict budget. * The server is likely to be the source of most required maintenance, if files are continually being stored, processed, and transferred via it. Expansions and constant checks to the storage devices might be necessary. * If the company moved to a virtual environment, the 3 Machine Room switches and router would have to remain, as they provide the backbone for internet access. The server would have to remain as well, as the network can be accessed through it.   **Packet Tracer Reflection:**  The most challenging aspect of the packet tracer section was correctly identifying a way that would lead to the correct isolation of the networks via VLANs. We eventually discovered that through the use of access lists, we can prevent inter-device communication for specified IP ranges.  Initially we had trouble with the subnet assignment in the access lists, until we realised that we require the wildcard value instead of the normal subnet value. This took a significant amount of time, but we figured it out eventually. We also struggled setting up the sub interfaces on the routers such that the separate VLANs can access them, as the type of router we used did not allow for VLAN assignment within packet tracer.  The most frustrating part of the project was the requirement of not being able to use switches with more than 7 ports outside of the machine room. This added some interesting wiring challenges, but it was solved through the use of 5 port switches (not available in packet tracer). This does, however, lead to us having a large number of switches in each office, but since they are small, this should not prove to be an issue.  The part that we enjoyed the most, was the initial network design, where we had to figure out how to create a network that would fulfil the bandwidth requirements as set in the project description. This led to interesting discussions about networks and helped us to understand the basics of creating a functioning network. |

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| Project ManagementWork-Ethic:  * Respect for fellow group members is crucial and non-negotiable. * We aim to have multiple and regular group meetings (online and in person) to ensure communication between members as well as updates on progress and challenges faced. * Roles and responsibilities should be clearly assigned and understood. Failure to complete responsibilities will be addressed and handled fairly and professionally. * If a member fails to do an assigned task multiple times in the designated time frame, and their reasoning for why they were unable to do it is insufficient, there will be a “hearing” among the group members to see what must follow. This hearing will determine their continued participation.  Managing Project Load: We used different remote working tools, including Discord and Google Docs, to keep track of tasks and deadlines. We scheduled regular discord meetings that helped us discuss beforehand how we would effectively use our face-to-face meetings when we had them. Google Docs enabled us to do our own work on our own time on one document, increasing productivity.  **Advantages:**   1. Flexibility: Working remotely helped improve productivity as every member could work at their own time and pace. 2. Productivity Increase: Members had more time to focus on work without interruptions. 3. No Geological Constraints: Members did not physically have to be on campus or together to get work done.   **Disadvantages:**   1. Communication challenges: Misunderstanding can occur more frequently than in face-to-face meetings. 2. Lack of personal interaction: Personal relationships and good team spirit is considerably harder to build when working remotely. 3. Technical glitches: Technological dependence increases chance of technical bugs and glitches like poor network connectivity and software issues.   **Lessons Learned:**   1. Importance of clear communication: Making sure that all team members understand their tasks and responsibilities is crucial. 2. Regular Meetings: Regular meetings can help members build team spirit as well as keep everyone on the same page. 3. Clear expectations and deadlines: Establishing clear expectations regarding responsibilities, roles, and deadlines is crucial. |

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| Messaging App Evaluation **Login/Sign Up:**  Little Birdie is a Real time chatting application developed using Python. The main python libraries used were Customtkinter for developing a GUI and Firebase to allow communication with Google's Firebase (An online database platform). Little Birdie requires users to create a new user using a unique username. Once this is completed a query is sent to Firebase to verify the existence of this username, if the query returns false the username is available to the user. If the query returns true, it means the username is already taken and the user should then try creating a new username. The username and an encrypted password are stored on Firebase to add additional security measures. Once the user has successfully created their profile, they login and proper validation techniques are in place to control access.    User can Sign in or Sign up.  Text box for username.  Text box for password.  After Login enter chat app.    Sign up with name and surname.  User can choose own username.  Create password and confirm.  Safes the user, user can now log in.  **Direct Messaging and Friends:**  Once the user has logged in, they are provided with a form in which they can then add a friend. A query is sent to the database to verify the existence of the friend and if the friend is present in the Database, is added to the User's friends and the User is then added to the newly added friend's friend list. This was done using a single batch query to combine multiple queries into a single batch, this greatly reduces bandwidth usage as well as increase the speed new friends are added. The user has the option to send direct messages to the friend, the message is also sent using a batch query to ensure minimal queries are being sent to the Database. The message is stored on both the user's and friend's side with a timestamp which was generated in Little Birdie.  Send messages and clear chats.  Type messages here.  Add/Remove Friend. Go to groups  Shows all user friends.  Shows all chats between users.  **Group Messaging:**  The user can navigate to the Groups page which is a separate Python class with its own interface. It is still in the same .exe file as the Login, Sign Up, and chat. The user has the option to Create a Group, by either ticking a checkbox for each friend they wish to add or by creating a group and adding members manually, these members do not necessarily have to be friends of the user, once a query is sent to add a non-friend to the group Firebase then confirms the existence of this member and proceeds to add the member to the group. The messages for Groups are only stored in one single Table called Groups, the Groups table has 2 collections, Members and Messages. By storing the messages in a single entity, the storage requirements are greatly reduced and there is even an increase in processing times.  Create new groups by adding users and group name.  Shows all chats between users.  Type messages here.  Send messages and clear chats.  **Communication With Firebase:**  Little Birdie uses a firebase .Json file to give Little Birdie access to connect to firebase. This acts as a small security measure because without this file Little Birdie will not be able to provide access to the Database. All communication is done with queries being sent from the user's device directly to the Firebase Database which is stored on Google Servers. Therefore, without proper Internet access, Little Birdie will not be able to provide communication.  . |

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| Reflection of Little Birdie Like various other development projects Little Birdie had numerous ups and downs. One of Birdie’s main mechanisms is a python function called “Listener”. The way this function was set up made it extremely difficult to implement to only give real time updates of one conversation or only receive the right number of messages. The main problem was when entering and leaving a conversation with a specified friend, another instance of the Listener function was initiated, this then created a problem where the user received the same message but multiple times. In other words, the listener was initiated every time the user leaves a specific conversation and rejoins it. Fortunately, there was an easy fix which only required 2 lines of python code to solve this error and ensure there was only one instance of the listener active at a time.  While giving the user control to create their own profile using a unique username, we had an issue where the user could enter a username which was already in the system, this is greatly problematic because Little Birdie uses the username of each user to uniquely identify a user and to load their messages, groups, and friends. The problem was solved by redeveloping our validation method where a query is sent to the NOSQL database Firebase to confirm the presence of this username in the system.  The processing times for sending group messages were not efficient and there was a 3 second delay before a message would appear, this results in users having slow communication with one another and greatly reducing productivity. We successfully solved this matter by restructuring the Groups table in the database to store all group messages in a singular place. Unlike individual messages where the messages are stored on both the sender and the receivers’ side, the group messages are all stored in a single location. This greatly increased the speed at which messages are sent and received, thus resulting in a smoother, more efficient experience. |

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| Timetable  |  |  | | --- | --- | | **Week 1 (4-10 March)** | Contact group members and become acquainted with one another. | | **Week 2 (11-17 March)** | Members complete courses and write reflections on them. | | **Week 3 (18-24 March)** | Divide work between members and start brainstorming ideas on how to solve the packet tracer problem. | | **Week 4 (25-31 March)** | Complete work ethic and other documentation that needs to be submitted. | | **Week 5 (1-7 April)** | Initial Network Design + Specifications | | **Week 6 (7-14 April)** | Topological Network Design | | **Week 7+8 (15-28 April)** | Finalise Packet Tracer Network | | **Week 9 (29 April - 5 May)** | Start coding the messaging application | | **Week 10 (6-12 May)** | Finalise messaging application and complete all documentation | | **Week 11 (13-16 May)** | Fix final bugs and errors and submit project. | |

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| Continuous Reporting **Week 1 (12 March):**   * Status: Completed * Highlights: All members have made contact and are acquainted with each other. * Attendance: All members present. * Discussion: Individual skill and expertise are discussed, along with the team members' introductions. * Decisions: Channels of communication and meeting times agreed upon. * Next Steps: Members will complete relevant courses and write reflections on them.   **Week 2 (13-17 March):**   * Status: Completed * Highlights: All members have completed relevant courses and written reflections on them. * Attendance: All members present. * Discussion: Exchanging thoughts on finished courses. A discussion of the project's potential applications and how the skills from the courses can help with its completion. * Decisions Made: Everyone needs to experiment with packet tracer and be comfortable with using it. * Next Steps: Lohard and Zane will start brainstorming ideas on how to solve the packet tracer problem.   **Week 3 (18-24 March):**   * Status: Completed * Highlights: We have collectively brainstormed ideas on how to solve the packet tracer problem (primarily used ideas from Lohard and Zane). Everyone is comfortable with packet tracer. * Attendance: Renier could not attend. * Discussion: Outlining potential solutions for the packet tracer issue. Talk about the division of tasks. * Decisions Made: Finalising each member's tasks and responsibilities. * Next Steps: Andre and Conrad will finalise the work ethic and other documentation that needs to be submitted.   **Week 4 (25-31 March):**   * Status: Completed * Highlights: Andre and Conrad have finalised the work ethic and other documentation that needed to be completed. * Attendance: All members present. * Discussion: Examining the finished documentation. Preparing for the network design phase. * Decisions Made: The documentation was approved. * Next Steps: Johan, Franco, and Jason will work on the initial network design and specifications.   **Week 5 (1-7 April):**   * Status: Completed * Highlights: Johan, Franco, and Jason have completed the initial network design and specifications. * Attendance: All members present. * Discussion: The first part of network design is presented. Preparation for the topological design of the network. * Decisions Made: The original network architecture and standards were approved. * Next Steps: We collectively develop the topological network design based on the initial design and specifications.   **Week 6 (7-14 April):**   * Status: Completed * Highlights: We have developed the topological network design based on the initial design and specifications. * Attendance: All members present. * Discussion: Review of the topological network architecture is discussed. Preparing for the network implementation phase. * Decisions Made: The topological network design was approved. * Next Steps: Andre will finalise the Packet Tracer Network based on the topological design.   **Week 7+8 (15-28 April):**   * Status: Completed * Highlights: Andre has finalised the Packet Tracer Network based on the topological design. * Attendance: All members present. * Discussion: Presentation of the completed Packet Tracer Network. Preparing for the development of the messaging app. * Decisions Made: The Packet Tracer Network was approved. * Next Steps: Stephan will start coding the messaging application that will be integrated into the network.   **Week 9 (29 April - 5 May):**   * Status: Completed * Highlights: Stephan has started coding the messaging application that will be integrated into the network. * Attendance: Lohard could not attend the meeting. * Discussion: An analysis of the messaging app's original iteration. Getting ideas for changes that can improve the app. Preparing for the messaging application's completion. * Decisions Made: Input received regarding the messaging app's initial iteration. * Next Steps: Renier, Ruan and Stephan will finalise the messaging application and complete all related documentation.   **Week 10 (6-12 May):**   * Status: Completed * Highlights: Renier, Ruan and Stephan have finalised the messaging application and completed all related documentation. * Attendance: All members present. * Discussion: Presentation of the completed messaging app and accompanying documentation. Preparing to submit the finished project. * Decisions Made: The messaging application and accompanying paperwork were approved. * Next Steps: All members will work together to fix any final bugs and errors, to finalise all documentation, and submit the project.   **Week 11 (13-16 May):**   * Status: Completed * Highlights: All members have worked together to fix any final bugs and errors, finalised all documentation, and submit the project. * Attendance: All members present. * Discussion: Project evaluation in its final form. Talk about any last bugs and mistakes. Minor additions or changes. * Decisions Made: The completed project was approved. * Next Steps: Project completed. |

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| Reflections on Task 1 **Lohard Janse van Rensburg – 37248529**  The completion of these online courses and various others helped me gain a good understanding of a set of soft skills that will benefit me greatly in my academic as well as my professional career. Time management, a skill I learned through the course on managing time, has made me more adept at prioritising tasks and creating realistic, reachable goals. The courses on Git have improved my skills in problem-solving, as I have learned to work effectively with other colleagues on projects and how to use version control systems.  The course on project management greatly improved my understanding of allocating resources and planning strategically, which are essential to creating successful projects. Additionally, the course on Cisco Packet Tracer helped me develop the needed technical skills, allowing me to gain hands-on knowledge of network setup and troubleshooting.  To conclude, these courses have all strengthened my soft skills in the areas of communication, teamwork, and adaptability. With the tools they have given me, I can now take on challenges head-on and work effectively in both solo and group settings. The ability to clearly communicate complicated concepts and to negotiate and resolve conflicts are skills that are needed in any profession. These soft skills complement technical knowledge and are essential to accomplishing business and personal goals.    **Renier van Rooyen – 43151906**  Having completed the prescribed courses as well as a few extra ones on the same topics, I have gained a greater understanding of the skills associated with things such as time management and working as a team. The skills I have gained are not limited to this project, and I feel like they will benefit me in my career going forward, as well as my personal life. Being able to manage time properly and having effective communication with other people involved in any endeavour is crucial and should not be overlooked.  The two courses on Git were also extremely helpful. Having had previous experience using Git and GitHub, I came in expecting to gain very little from these courses. The first, introductory course was not the most helpful as I already understood the basics of the Git software. The second course was where I gained the most knowledge. This course was a deep dive into one of the most widely used and important tools in our field. I finished this course satisfied that I knew how to use Git properly and that makes working on projects such as these so much easier.  The course on Cisco packet tracer helped me to understand how to properly design and simulate network environments. I also learned how to troubleshoot issues correctly and learned how to use this software in my projects.  To summarise, I feel like I have gained or improved many soft skills that pertain to the topics discussed in the five courses. I believe I now understand the basics of Git and Cisco packet tracer, as well as being able to manage my time better and having good communication.  **André du Raan – 35476087**  From the time management course, I learned that setting up routines is a critical aspect to improving work focus, and that breaks in between work sessions are just as important as consistent effort, in order to stay motivated and in a productive mindset.  The Git courses taught me the fundamentals of git, i.e. interactions such as staging, pushing, and pulling, workflows and proper repository management. I also learned about useful software such as SourceTree that enables much easier Git interaction through a GUI. It taught me about using git from a command line, however we will most likely not make much use of command line git, preferring GitHub’s intuitive UI.  The project management short course taught me essential steps in approaching a complex project such as this one, with a project plan being essential to completion. It also introduced me to useful project management software in the form of Microsoft Project, which I was previously aware of, but never thought of using until now.  The courses on packet tracer taught me the fundamentals of using the program in both the logical and physical design aspects, including how to create complex interconnected networks and the basics of proper cybersecurity implementation within a network through correct routing and checks.  In conclusion, these courses taught me all essential skills needed in order to successfully complete our project.  **Johan-Louis Coetzee – 40887340**  The time management course provided me with effective methods to better utilize my time like having a set morning routine, taking breaks, working for set periods of time completely uninterrupted and prioritizing work. It also included 2 excel sheets to further help with setting up a morning routine, general time management and reaching goals I set for myself.  The Git/GitHub courses demonstrated how to utilize commands like commit and add while also covering topics such as the fundamentals of Git, the value of version control, and the process of transferring files between local and remote repositories using GitHub. My grasp of version control systems was further enhanced by learning about programs like SourceTree. These courses have given me the practical know-how to not only manage projects well but also work well in teams by utilizing GitHub and Git.  Having finished the project management course, I feel as like I have gained a better understanding of project planning, execution, and monitoring through the use of tools like Primavera P6 and Microsoft Project (MSP) and methodologies like the Critical Path Method (CPM).  The CISCO Packet tracer courses really helped with the technical and practical side of creating network simulations.  In conclusion these courses have not only equipped me with the skills I need to complete the project but also skills that I will be able to use for the rest of my life and in my professional career.  **Zané Kennard – 40898989**  I have learned a lot from these courses starting with the time management course. One thing that they mentioned and that stuck with me and got me thinking, was “Is your time well invested”. This stayed with me because it is easy to say that I have had a productive day but was my time well invested?  The most important time management element is having a morning routine to get you in the right state of mind for the rest of the day. By visualizing my success, exercising, and writing down my goals, I could start my day in a great mind space, and consequently better my time management.  I have learned that GitHub is an application that allows you to store remote repositories while Git is a source control software allowing you to take snapshots and distribute your creations and modifications over time. SourceTree is a Git GUI that allows you to interact with your repositories through a graphical interface. These courses expanded my knowledge about Git and GitHub which will be very useful for future projects and my future work environment.  The Cisco Packet Tracer course really helped me understand the application and I must say it is one of the most interesting things I have worked with in a while. The way it works is so realistic, I am fascinated by it. The project management course taught me that all projects are carried out under certain constraints mostly consisting of cost, time, and scope.  **Ruan van Heerden – 41763882**  Not only have I gained a clear understanding of the courses, but I believe that it has also provided me with knowledge that I can use in the rest of my studies as well as my career. From the time management course, I learned how to divide my time and set up routines to improve my work focus. This includes morning routines, working for set periods of time and taking necessary breaks.  The Git and GitHub courses were familiar as I have worked with it before, but it gave me a clearer and broader understanding of how to use it properly and effectively. I now know how to better utilise commands like add and commit and I understand the fundamentals and the use of version control systems. These courses were very important and useful as it is a popular platform for collaboration between colleges.  Upon completing the project management course I have gained better insight in planning, executing, and monitoring of projects. I came to understand the value of management tools since they provide everyone with the most recent information on the state of the project. I also realised that tools like MSP and CPM as well as techniques such as SMART are valuable in future projects.  I have never worked with Cisco Packet Tracer, so the interactive course gave me a clear understanding of how to properly set up a network. I also now understand both the logical and physical design aspects of how to properly create a complex network.  **Jason Coetzee – 40821749**  Taking the "Manage Your Time" course was a total game-changer for me. I've always struggled with balancing work and my personal life, but this course provided me with useful tools to manage my time efficiently. Setting realistic goals and prioritising tasks has completely changed the way I live my daily life.  I always knew Git was important, but I never fully understood how it all worked until now. Learning to navigate GitHub has been a game-changer, especially when it comes to working with others on coding projects. I also realised that diving a bit deeper into Git and GitHub was very beneficial, learning things like conflict resolution techniques and the implementation of sophisticated branching strategies.  “Project and Project Management” showed me that it’s one thing to come up with a great idea, but this course showed me that turning that idea into reality requires a whole different set of skills. Learning about project planning, execution, and evaluation made me realise just how much goes into the successful completion of a project. This course also made me aware of various project management tools such as Microsoft project and Primavera P6 as well as the very useful Critical Path Method (CPM).  I’ve always been fascinated by networks, and the “Cisco Packet Tracer” course made me realise that building and simulating networks from scratch was both challenging and incredibly rewarding. In the past I never knew how networks were set up and created, but after this course I now know where to start.  **Franco Burger – 24904635**  Time management is a skill I have difficulty mastering, given numerous attempts at learning the skill. The course that was provided simplified a lot of key points I usually struggle with, and it aided in my realisation of what I need to work on. After the course I wouldn’t say my time management is optimal, but I will however say it is better than it used to be.  Given that we had to use GitHub in previous projects I didn’t expect to learn too much from the provided courses. I was, however, pleasantly surprised that there were new things to learn and some things I forgot about. The refresher course, as I choose to refer to it as, made relearning GitHub and its capabilities worth the time it took to work through the course.  Project management is a skill that can always be improved as no project is the same as the last. So, learning old techniques and a few new ones will make working through the project simpler than it would’ve been without these skills. Managing a project by yourself is a challenge on its own, but having to manage a group project with so many members is another challenge entirely. Having good basic skills from the course will make strong groundwork to build on and learn as the project evolves.  **Stephan Schmidt – 35459980**  I have learned various helpful skills from these courses which will prove vital to my success in this module as well as in my work life experience one day. I have learned time management skills, in essence I learned how to better utilize my time more effectively to achieve more results in less time. I have learned how to balance various aspects of my life to achieve better productivity.  GitHub and similar platforms are one of the most common tools a programmer and an individual/group who does projects will utilize. Learning how to utilize this platform as soon as possible is extremely beneficial towards your career. By learning GitHub I have learned various important aspects of programming such as collaboration with other programmers and individuals in a team, how to make use of version control to manage the current version of the program, which also allows backtracking if the current version of the program is in a poor state.  By learning the Packet Tracer application, I have obtained a more complete understanding of how to design and plan a network.  The project management course has taught me how to manage various aspects of a project to obtain the desired results from developing this project. Project Management can be a difficult task if the project is not steered in the right way and by maximizing the effectiveness of available resources.  Having never seen or used the packet tracer software the course was very engaging and helped understand the software for use in the project.  **Conrad Nicolas Du Toit – 34386084**  I always struggle with time management and finish assignments and tasks on time without rushing it. I learned the importance of prioritizing and not wasting my time with other less important things before finishing what’s important.  I already knew a bit about using GitHub and how to install it from previous projects and experiences, but it was good to be refreshed on how it works and to learn about new and interesting ways that it can assist me in completing and simplifying my project and work. For instance, the command-line functions with git bash, how to do it in a Linux based system, more in depth theory on how git and branches work and the differences between git and GitHub.  In regard to project management, I learned the importance of proper resource management and what the appropriate steps could be to solve complex problems in an efficient and productive manner without compromise. It also showed me helpful software (Microsoft project, Primavera P6) and other techniques (PERT, CPM) that I can use for managing my projects and simplifying the process.  CISCO Packet Tracer showed me the basics of how to design and program network environments, as well as the basics of troubleshooting, routing, and security checks.  In summary these courses greatly improved my knowledge of networks, git and management that are essential skills for me to complete this project and many more. |

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| Reference List **Labour Costs:**  <https://thenetworkinstallers.com/blog/how-much-does-it-cost-to-install-network-wiring/>  **TP LINK 5-port Switch:**  [https://www.takealot.com/tp-link-litewave-5-port-gigabit-desktop-switch-plastic-case/PLID70573390?gclsrc=aw.ds&gad\_source=1&gclid=CjwKCAjw9IayBhBJEiwAVuc3frBpOA4wlG70v\_8R4\_LrOPJwFbaBl0riE\_MMjql4nNdra0-7J\_1TfBoCaHQQAvD\_BwE&gclsrc=aw.ds](https://www.takealot.com/tp-link-tl-sg108-network-switch/PLID28720019?gclsrc=aw.ds&gad_source=1&gclid=Cj0KCQjw6PGxBhCVARIsAIumnWZZSR0CHDttsqDq4rjjj-1CyOwSVVlrpCuSihCsnJg-QPm_2V5DRUgaAhq5EALw_wcB&gclsrc=aw.ds)  **CISCO 3650 24-port Switch:** <https://www.ebay.com/itm/364587739800?itmmeta=01HXEZFF22F18V1ZNW27AJ6B1G&hash=item54e31f6a98:g:dswAAOSwWC1ic5Dh&itmprp=enc%3AAQAJAAAA8D03%2FwWQSAvoubCs2sW1836802XuER41jdrLsVUof9bzY9rzTbLpvWCZ%2BI4sd9xAGBTx6c2u1bmx8M1U0xET0SF12nSA6RRl69YBqSjEhR2tOafC68Jyf0BU2X8n6XiOODo93QbKRBxVHWx3%2B6M6PukSFcYvYdS3C4gvG5hhsNIz8l7Wb2W%2BqdwE6S8UjmQUp%2BFH%2FoBUNKB9zdyuKFsMcPUXO4yqLsRQCWaWNx1Ov03%2F%2BgvE0NiwSsQvNEdP4xi%2Be8REIn%2BRjDIqZP1VxfzsBAfhrO51GNzMRB7im7quF%2B6Eejv12mPCG5TrI9scZeUlQQ%3D%3D%7Ctkp%3ABFBMjPG93-tj>  **MikroTik Cloud Core 16 Port Gigabit 2SFP+ 4 Core Router | CCR2004-16G-2SFP+:** [https://www.takealot.com/mikrotik-cloud-core-16-port-gigabit-2sfp-4-core-router-ccr2004-1/PLID90448991?gclsrc=aw.ds&gad\_source=1&gclid=CjwKCAjwupGyBhBBEiwA0UcqaCCCgUjLhbAyjwKIjWKOARyCGbG-H4-ORexuf5FUzUm2BgSTQAI2bhoCyeYQAvD\_BwE&gclsrc=aw.ds](https://www.incredible.co.za/tp-link-archer-ax6000-wi-fi-router?gad_source=1&gclid=CjwKCAjw9IayBhBJEiwAVuc3fmMX3OmlJyUEXoymcnvA75Q_eZA1bc_AblmVb_Vdt79eQv-VKaZ-kxoCEgkQAvD_BwE)  **TENDA AC8 Wireless Router:**  <https://www.makro.co.za/electronics-computers/wifi-networking/routers-modems/routers/tenda-ac8-wi-fi-5-wireless-router---dual-band-2-4ghz-and-5ghz-gigabit-ethernet-black/p/acf4105c-f56d-44e5-b45c-9ff534520597?gad_source=4&gclid=Cj0KCQjw6PGxBhCVARIsAIumnWYrGJLj_H1h8JUkDu4R5tf1tTEHhhIyvDj4PtqP4DzqdnVBmpzNmL4aArwjEALw_wcB>  **Cat5e LAN Network Cable - 50m:**  <https://www.takealot.com/cat5e-lan-network-cable-50m/PLID52541076>  **Cat5e LAN Network Cable - 22cm:**  <https://www.takealot.com/5-pack-22cm-cat5e-flylead-ethernet-network-patch-cable-white/PLID91336583>  **Example job listing used to calculate labour costs:**  <https://www.pnet.co.za/jobs--Wireless-Networking-Technician-Blouberg-West-Coast-Personnel--3759332-inline.html?rltr=1_1_25_seorl_m_0_0_0_0_0_0> |