Project brief

Project title	Principles and Design of Networked Systems
Module Name	IT Systems & Networks
Course Name	Higher Diploma in Software Engineering
Project Start date	(Refer to schedule)
Project Submission Date	(Refer to schedule)

Purpose of this assignment

This Assignment is used for the following:

- Summative Assessment of students in the Module 'IT Systems & Networks 'Higher Diploma in Software Engineering'

In this assignment, you are required to examine networking principles and their protocols, explain networking devices and operations, design efficient networked systems and implement and diagnose networked systems.

This project gives you an opportunity to demonstrate your capabilities in the following areas:

- Knowledge of security, the associated risks and how it has an impact on business continuity.
- Examine security measures involving access authorization and regulation of use. They will implement contingency plans and devise security policies and procedures.
- Detection of threats and vulnerabilities in physical and IT security, and how to manage risks relating to organizational security.
- Network security design and operational topics, including address translation, DMZ, VPN, firewalls, AV and intrusion detection systems

Note: The tasks in this project are designed to manage network security for an organization.
In real applications, you might do it based on specific needs.

Scenario

You are a Junior Network Administrator at Swift & Bacon Publishers (SBP) Ltd, a medium-sized company that deals with the publication of books and journals for the scientific and technical community. Books are published both as physical and electronic copies.

SBP Ltd is currently situated in two office buildings and contains four Publishing Teams that deal with subject-specific material: a team for Computer Science and Engineering, a team for Maths and Physics, a team for Biological and Chemical sciences and a team for the Biomedical Sciences.

Each Publishing Team has a Publishing Team Leader (PTL), and up to 20 Publishing Editors (PE). Each team has their own secured area on the network. Each PE has access to their own content only, as well as any shared team documentation, but they do not have access to any other documentation.

The PTL can access all material for that team. There is an area for SBP company documentation that anyone can view. SBP receives manuscripts securely from their authors into an encrypted Public Repository Server (PRS) located on the premises. The manuscripts are then extracted from this repository by one of the four PTLs, who then assigns the manuscript to the PE. All documentation and office software are located on a company file server. Once a manuscript has been reviewed, it is uploaded to the Secure Publishing Server (SPS) where the content is either sent electronically to an external printing company or is available for download by paying customers.

SBP also maintains a team of three Network Administrators who have full admin access to the entire network. There is also a Senior Publishing Manager and CEO who have access to all company documentation.

Since the 2020 pandemic, the company has realized that a hybrid working model is now most effective for their employees. SBP is planning to close one office building completely to allow staff to work from home if they choose.

SBP wants to set up their remaining building in the following physical configuration.

- The PRS and SPS servers are in a data centre on the top floor
- The middle floor is a suite of five public meeting rooms with full wired and wireless access
- The Network Server Room containing the company network and email servers is on the middle floor
- The network administrators are also located on the middle floor.
- One network administrator must be present in the building each day. The on-site network administrator uses a desktop machine for server administration.
- The ground floor is to be a collection of 20 open-plan ‘hot desks’ where employees who choose to come into work can go to any desk, plug their laptop into the cabled network and begin working.

To facilitate working from home the company wants the following.

- Each employee is to be issued with a company laptop
- The laptop will contain a software firewall, as well as VPN client
- Employees will store company data on the company fileservers
- A high-throughput VPN server will need to be installed and configured to allow secure connectivity for all remote working employees
- The security model of all company data must be preserved
- All office software must be accessed using a cloud-based delivery model, e.g. Google Docs, Office 365
- Each employee is to be based in mainland UK.

SBP also wants to explore moving the company data located on the fileserver to a cloud-based offering such as SharePoint or Google Workspace, but they are also happy to maintain a fileserver within the data center if necessary.

The SBP network requirements are that:

- the data center can handle high-volume traffic of data from inside and outside the organization
- the ground and middle floors have a mixture of wired and wireless connectivity
- all Publishing Teams are isolated from each other
- there is proper consideration given to network security to minimise a data breach
- a firewall will need to be installed and configured to allow inbound and outbound traffic
- there is no lag of data traffic between floors and no connectivity ‘dead spots’
- any data sent to a cloud server or stored on the RPS server is encrypted.
- there are robust backup facilities in place for the SBP data in case of a data loss or security breach
- the current network security model for teams and employees is preserved even though employees are working from home.

The SBP CEO and Senior Network Administrator has asked you to design and build a virtual network solution that will fulfill the company requirements. This will help SBP to identify any potential issues in the requirements before spending money on closing a building and reorganising the remaining building layout and employee requirements.

In addition, SPB wants you to create a presentation for them, showing the range of available networking topologies, protocols, hardware and software, to demonstrate that you have the breadth of knowledge available to you before you begin the design task.

Activity 1

Produce a formal presentation (with supporting notes) for the CEO and Senior Network Administrator of SBP Ltd that explains the core principles of networks and networking protocols. The presentation will also include a discussion of the range of network hardware and software available to the systems developer.

Your presentation should include:

- a discussion of the benefits and constraints of different network types, e.g. wired, wireless, hybrid
- a discussion of the benefits and constraints of different network standards, e.g. OSI, TCP/IP, 802.x
- an explanation of the impact of network topology, communication and bandwidth requirements, identifying the advantages and disadvantages of each to a network design
- an assessment of common networking principles and how network protocols, e.g. IPv4, IPv6, HTTPS, can enable an effective networked system
- a discussion of the operating principles of networking devices and network server types,
- e.g. routers, switches, firewalls, repeaters, bridges, IoT gateways, domain, web, file and database servers, access permissions
- a discussion of how workstation hardware and the relevant networking software depend on each other.

Activity 2

You are required to design a networked solution for the requirements specified by SBP Ltd. You should make use of whichever design tools and techniques are most appropriate for your network and for the nature of the networked solution. You should produce your evidence as an implementation plan.

Your implementation plan should include the following

- The design of the network, including any networking hardware, software, network addresses and devices and users, including any network sub domains as well as the physical location of these devices within the organisation
- Any device configuration and security considerations should be included
- The design of a maintenance schedule to support the networked system
- A test plan covering all areas of the networked system requirements, indicating the test action, test data and expected results
- Feedback from a range of users on the effectiveness of the solution design
- An analysis of the user feedback with the aim of optimising the design and improving the efficiency of the networked solution
- A clear explanation of how the network designs have been optimised and improved
- An explanation of the range of network server types available required by the SBP scenario and a recommended selection
- A justification of the recommended server selection, with specific focus on cost and performance optimisation.

Activity 3

You are required to implement a virtual networked solution for the requirements specified by SBP Ltd. You should make use of whichever virtual network simulator is most appropriate for your optimised network design and for the nature of the networked solution. You should produce your evidence as a technical report.

Your report should include:

- clear evidence for the implementation of the optimised design, for example screenshots, configuration files, annotated and verified demonstration evidence, network monitoring reports
- a test plan implementation, using the test plan designed in Activity 2, clearly documenting the test results against the expected results
- an analysis of the results of the test plan and, based on this, recommendations of potential enhancements for the networked system.

Activity 4

Write an evaluative report for the CEO and Senior Network Administrator of SBP Ltd that provides a reflective overview of the selected topology as well as the network design and implementation.

Your report should include:

- an evaluation of network topology and any protocols selected for the given SBP scenario
- an evaluation of how the topology and protocols demonstrate the efficient use of a networking system
- a critical reflection on the final implemented network and design
- a critical reflection of the decisions made to enhance the network design and the implemented solution.

Project Technical Environment

The student should perform the project in the below environment.

The student should have the following tools installed on his / her windows Laptop.

- Packet Tracer
- Microsoft Word
- Microsoft PowerPoint
- Visual Paradigm

Project Guidelines

You should follow the below guidelines while implementing the Project:

- Implement the project in the technical environment specified in the Project brief
- Follow the format specified for Project Report and Project Presentation
- The project report and presentation should be submitted at least 2 days before the date of Summative Assessment date.
- This project is not implemented with a complete development and implementation team and hence you may seek guidance from the tutors regarding the integration issues with other modules / software components.
- Present the Milestones in every Tutoring Session and seek the Tutor's feedback and review. Incorporate the feedback in your project.
- Attach all project evidence for each milestone as part of your Project report.

Project Assumptions

You can make following assumptions can be made while implementing the project:

- This project is not for commercial use and hence not fine-tuned for performance, but it is desirable that you focus on performance issues and address them, if any.

Sample Questions for Assessor

- Can you explain the basic components of an IT infrastructure?
- How do you differentiate between various types of networks (LAN, WAN, MAN)?
- What are the different types of network topologies, and what are the pros and cons of each?
- Can you explain the function of common networking protocols such as TCP/IP, HTTP, and FTP?
- How do protocols like DHCP and DNS work, and why are they important?
- What are the best practices for securing a network against threats?
- How do you implement firewalls, VPNs, and intrusion detection systems (IDS)?
- What are the key differences between on-premises and cloud-based IT systems?