**Project Report**



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| **Product Name** | Higher Diploma in Software Engineering (HDSE) |
| **Qualification Name** | Higher Diploma in Software Engineering |
| **Project title** | **Principles and Design of Networked Systems** |
| **Module Name (HDSE)** | IT Systems & Networks |

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| **Learner declaration** |
| I certify that the work submitted for this assignment is my own and research sources are fully acknowledged.  Student signature:  Date:7/20/24 |

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# Project Background

Swift & Bacon Publishers (SBP) Ltd is a medium-sized company specializing in the publication of scientific and technical books and journals. SBP operates from two office buildings and supports a hybrid working model, allowing employees to work both remotely and on-site. The organization consists of four subject-specific Publishing Teams, each managed by a Publishing Team Leader (PTL) and supported by up to 20 Publishing Editors (PEs). SBP's network infrastructure includes secure servers for managing manuscripts and publishing content, with a need to maintain high security and efficient data handling.

Given the company's recent shift towards hybrid working, SBP plans to close one office building and reconfigure the remaining building to support both on-site and remote work. This reconfiguration involves setting up a secure, efficient, and robust network infrastructure that caters to the needs of employees working from home and those who choose to work from the office.

1. **Project Objective**

* Improve Remote Working
* Reconfigure Infrastructure
* Upgrade Network
* Better Security
* Networking Solutions

1. **Requirement Specification**

* **Network Infrastructure (Top Floor, Middle Floor, Ground Floor)**
* **Remote Work Capabilities: Company Issued Laptop and VPN Server**
* **Security**
* **Connectivity**
* **Data Management**
* **Employee Management**

# Task 1

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| Network Types | Benefits | Constraints | Examples |
| Wired | -Stable and reliable connection  -High speeds with low latency  -Less susceptible to interference | -Limited mobility  -Requires physical cables  -Higer costs in a complex environment | -Ethernet (LAN)  -Fiber Optic Networks |
| Wireless | -Great mobility and flexibility  -Quicker to deploy  -No cables | -Might be affected by interference  -Slower compared to wired  -Possible security concerns | -Wi-fi  -Cellular Networks |
| Hybrid | -Combines advantages of wireless and wired  -More scalable and flexible design | -Complex network management  -Expensive to deploy and maintain  -Integration issues | -Corporate Networks (wired LAN and wireless access)  -Home networks (Ethernet and Wi-fi) |

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| Network Standards | Benefits | Constraints | Purpose | List of Layers |
| OSI Model | - Provides a comprehensive framework for network architecture  - Helps in troubleshooting and standardizing protocols  - Easy to understand and teaches network fundamentals | |  | | --- | | - The model is theoretical and not always practical  -Implementation can vary | | |  | | --- | | - To standardize network functions and facilitate interoperability between different systems | | |  | | --- | | 1. Physical  2. Data Link  3. Network  4. Transport  5. Session  6. Presentation  7. Application | |
| TCP/IP Model | - Practical and widely used for real-world networks  - Simplified compared to OSI  - Focuses on protocols that are in use today | - Less granular than OSI  - Can be less helpful for detailed network troubleshooting | - To define the protocol suite used for communication over the internet | 1. Link  2, Internet  3. Transport  4. Application |
| 802.x | - Defines various aspects of local area network (LAN) standards  - Ensures compatibility and interoperability  - Supports high-speed networking | - Each standard has different applications and may not be compatible with each other  - Implementation complexity | - To provide standards for different types of network interfaces and technologies | - Specific layers vary by standard, but commonly include physical and data link layers.  Examples:  - **802.3** (Ethernet)  - **802.11** (Wi-Fi)  - **802.15** (Bluetooth) |

**Impact of Network Topology, Communication, and Bandwidth Requirements**

**Network Topology**

* Network topology defines the arrangement of devices and connections within a network. It directly influences data flow, performance, and security. There many types of topologies, which include:
* **Star Topology:** In a star topology, all nodes are connected via a central hub or switch

**Advantages:**

* + - * Easy to set up and understand
      * One device failure won’t affect others
      * New devices are easily added

**Disadvantages:**

* + - * If the hub fails, entire network is affected
      * Require a lot of cabling
* **Bus Topology:** Devices are connected via a single central cable. Like a bus going from point a to point b

**Advantages:**

* + - * Simple and Cost Effective
      * Suitable for small networks

**Disadvantages:**

* + - * If the single cable breaks, entire network is down
      * Degradation of performance with more devices
* **Tree Topology:** Structured like a tree where a root node branches out into multiple nodes

**Advantages:**

* + - * Clear parent child relationships
      * One device failure won’t affect others
      * New devices are easily added

**Disadvantages:**

* + - * If the root node fails, entire network is affected
      * Complex cabling
      * Expensive
* **Ring Topology:** Devices form a loop making a circle

**Advantages:**

* + - * Simple and predictable
      * Only one device can transmit at a time

**Disadvantages:**

* + - * If one device fails, entire network is affected
      * Difficult to remove and add devices

**Communication**

* Communication ensures seamless data exchange between devices and users within a network. It’s like the network’s “language” that allows devices to talk to each other effectively. Some methods include:
* **Twisted Pair Cables:** Twisted pair cables consist of wires twisted together in pairs. They are cost-effective, easy to install, and suitable for short distances. However, they have limited bandwidth and are susceptible to interference from other electrical equipment.

**Advantages:**

* + - * Affordable and widely available
      * Easy to set up and disassemble
      * Suitable for short distances

**Disadvantages:**

* + - * Limited bandwidth
      * Susceptible to interference
* **Fiber Optic Cables:** Fiber optic cables use light signals for data transmission. They offer high performance, immunity to electromagnetic interference, and long-distance connectivity. Their bandwidth is excellent, making them ideal for high-speed applications.

**Advantages:**

* + - * Immunity to electromagnetic interference (EMI)
      * Exceptional data transmission speeds
      * Suitable for long distances

**Disadvantages:**

* + - * Complex to terminate
      * Delicate cables, quite fragile
      * Expensive
* **Wireless Networks:** Wireless networks provide mobility and ubiquitous access. They allow devices to connect without physical cables, making them versatile for various scenarios. However, wireless networks trade off bandwidth and security considerations.

**Advantages:**

* + - * Doesn’t require physical cables
      * Accessible network within area of coverage
      * Relatively easy to add new devices to

**Disadvantages:**

* + - * Lower bandwidth compared to wired connections
      * Easily intercepted signals
      * Susceptible to interference from other devices and physical obstacles

**Bandwidth Requirements**

* Bandwidth refers to how much data can be sent or received through a network link in a given time. It’s like the network’s “highway capacity”—enough bandwidth ensures smooth data flow, while insufficient bandwidth leads to congestion. Its impact to network design include:
* **Capacity:** Determines network’s ability to support activities.
* **Design Principles:** Structured cabling system design.
* **Data Rates:** Higher data rates require more bandwidth.
* **Considerations:** NEXT (near-end crosstalk) and external noise.

Higher bandwidths are usually sought after but lower bandwidths are more cost effective.

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| **Network Server Types** | **Operating Principle** | **Function** | **Impact** |
| Routers | Operate at network layer | - Connect different networks  - Route data packets between networks  - Choose optimal paths for data transmission | - Enables communication between networks  - Manages data traffic efficiently  - Enhance connectivity to network |
| Switches | Operate at the data link layer | - Connect devices within a local LAN  - Forward data based on MAC addresses  - Improve network efficiency | - Facilitate device communication  - Reduce unnecessary traffic  - Enhance LAN performance |
| Firewalls | Operate based on predefined rules | - Control access for networks  - Inspect packet headers and manage traffic  - Blocks threats | - Protection from unauthorized access  - Safeguard sensitive data  - Prevent malicious traffic |
| Repeaters | Operate at physical layer | - Amplify weak signals within the same network  - Extends signal transmission distance | - Extend network coverage  - Prevent signal degradation |
| Bridges | Operate at the data link layer | - Connect two LANs on the same protocol  - Filter content based on MAC addresses | - Efficiently segment LANs  - Enhance network performance |
| IoT Gateways | Serve as intermediaries between IoT devices and networks. | -Aggregate data from IoT devices  - Convert protocols for seamless communication  - Provide security | - Enable IoT device integration  - Ensure data interoperability  - Enhance IoT system security |
| Domain Servers | Manage domain names an IP addresses | - Resolve domain names to IP addresses  - User authentication | - Facilitate user-friendly web browsing  - Enable centralized authentication |
| Web Servers | Serve web content to clients | - Respond to HTTP requests  - Host websites and web applications | - Efficient web page delivery  - Enable online presence for businesses |
| File Servers | Store and manage files for network users | - Centralize file storage  - Provide access control and permissions | - Facilitate collaboration  - Ensure data consistency  - Improve data security |
| Database Servers | Manage databases and handle queries | - Create, read, update, and delete data.  - Handle transactions | - Optimize query performance  - Ensure data integrity |

# Task 2

Task Statement :

Task Solution :

Task 3

**Task Statement :**

Task Solution :

# Task 4

Task Statement :

Task Solution :



# Bibliography