**COIT 20264: Network Design**

**Term 1, 2023**

**Assignment 2: Final Report of Logical and Physical**

**Network Design**

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# Executive Summary

The objective of the network design project is to create a reliable and effective computer network for Prestige Auto Mart (PAM), an Australian car dealership with locations in many major cities. A network infrastructure that supports PAM's operations, including automobile sales, fleet services, web portals, and customer management systems, is what the project aims to build. High availability, security, and performance standards must be met while considering possibilities for both limited and unlimited budgets.

The project's scope includes choosing networking and communication tools and applications, as well as designing network connections between the main office and branch offices and LAN connections inside each office. There are two design possibilities offered: one with a minimal budget and the other without any financial restrictions. Additional features like cloud-based servers and an optional IPv6 address evaluation are included in the limitless budget design to improve network security and speed.

Business and technical goals, as well as any pertinent trade-offs and restrictions, are established in order to accomplish the project's objectives. To guarantee effective data transmission and user access, user communities, data repositories, network applications, and traffic flows are examined. In order to provide clear identification and communication inside the network, addressing and naming techniques are devised.

For both limited and unlimited budget designs, logical and physical network diagrams are offered, displaying the connectivity and device placement. To provide the best possible network performance and data security, routeing and switching protocols are chosen.

A thorough test strategy is created to verify the network design. The test strategy covers regression testing, throughput testing, availability testing, and application response-time testing. Each test scenario is executed according to comprehensive test scripts.

In conclusion, the suggested network design for PAM satisfies the technical and business needs while taking financial constraints into account. The network design's deployment will improve PAM's operations, customer service, and support for future growth. In conclusion, the suggested network design for PAM satisfies the technical and business needs while taking financial constraints into account. The network design's deployment will improve PAM's operations, customer service, and support for future growth.

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# 1 Project Goal

The project goal of this report is to design logical and physical network infrastructure that connects headquarter in Melbourne with its branch offices in Sydney, Perth, Brisbane, Darwin, and Hobart. The network should allow secure and dependable access to customer information and car stock records, as well as the online web portal and mobile app that consumers may use to place orders and make payments. It should also enable effective communication and data transfer between the offices. Furthermore, the proposal of no budget limitation, the addition goals are to explore the use of cloud base servers and consideration of adopting IPv6 addresses to improve the network infrastructure.

# 2 Project Scope

The project's scope includes creating a computer network to link Prestige Auto Mart's (PAM) central office and branch offices spread across significant Australian cities. The network will enable smooth data sharing, cooperation, and communication between the offices. It will guarantee that real-time stock levels, reservations, and client information are accessible around-the-clock. Implementing strong security measures, integrating a CCTV system for showroom monitoring, supporting online web portals and mobile apps for customer orders and payments, enabling automated order processing and delivery, and considering cloud-based servers and IPv6 addresses for enhanced performance and security with cost-benefit analysis are all included in the scope of the project.

# 3 Business Goals and Constraints

## 3.1 Assumptions

Logical Network design for any business is the implementation of various entities on a network to manage resources, operations, and various other constraints. The following proposal identifies, elaborates, and defines the various entities that are required to address while designing logical computer network for Prestige Auto Mart (PAM).

Following assumptions are made by analysing the scenario of PAM before starting the network design:

* There will be 200 users for the web application and the mobile app per day.
* There are 20 employees in each branch including delivery drivers.
* uptime for limited budget is 98.70% and uptime for unlimited budget is 99.999%
* There are 10 computers, 20 wireless devices, 15 cameras, 1 server and 2 printers in each branch.
* There are 10 guest users in each branch using Wi-Fi network.
* The limited budget uses 100 mbps NBN fiber whereas unlimited budget uses 1 Gbps NBN.

## 3.2 Business Goals

* The network should serve PAM’s business objectives, provide seamless experience to the customers while using services from PAM like buying, selling, leasing, or exchanging new and old vehicles.
* The network should ensure the smooth integration of all PAM offices and showrooms across key Australian cities including efficient communication and collaboration between them.
* The network should enable PAM’s online portal and mobile app, allowing customers to place orders and make online payments.
* The network should be available 24 hours a day, seven days a week to track the vehicle fleet’s real-time state, reservations, and customer information.
* The network must protect the security of PAM’s proprietary algorithm as well as the various data and information stored in its information system.
* Since PAM is new in the business, a scalable network design to accommodate future growth and expansion.

## 3.3 Business Constrains

* There is a budget limitation for minimum budget design options.
* The availability of the network should be high as it processes real-time data 24/7.
* The network design should support the mobile devices used by distribution truck drivers which are connected to PAM’s city offices.
* Seamless integration with PAM’s on-site customized proprietary software.
* Delivering cost-effective solutions while satisfying all business goals.

# 4 Technical Goals and Trade-offs

## 4.1 Technical Goals

* Prestige Auto Mart (PAM) requires a network architecture that ensures high network availability and reliability to minimize downtime, that provides performance for real-time reservations and processing of customer orders.
* Seamless data sharing and communication between the branches
* Implement a secure network design to protect sensitive data and prevent unauthorized access.
* Optimize network performance to ensure a seamless user experience.
* Convenient and secure payment system for online and on-site payment transactions.
* The network must support an integrated CCTV system for all showrooms while ensuring the security and confidentiality of all data and information.
* Provide a cost-effective network design that meets the client's budget constraints.

## 4.2 Trade-offs

### 4.2.1 Minimum Budget

For minimum budget, affordability takes priority as budget is low, but availability is given highest number as network needs to be available 24/7. Due to this security is being major trade-off parameter.

Table 1: Trade-off table for minimum budget

|  |  |
| --- | --- |
| Scalability | 5 |
| Availability | 30 |
| Network performance | 15 |
| Security | 10 |
| Manageability | 5 |
| Usability | 5 |
| Adaptability | 5 |
| Affordability | 25 |
| Total | 100 |

### 4.2.2 Unlimited Budget

For unlimited budget, network performance and security are taken in consideration compared to limited budget. While making more secure network, user convenience is being the trade-off parameter.

Table 2: Trade-off table for unlimited budget

|  |  |
| --- | --- |
| Scalability | 10 |
| Availability | 30 |
| Network performance | 20 |
| Security | 20 |
| Manageability | 5 |
| Usability | 5 |
| Adaptability | 5 |
| Affordability | 5 |
| Total | 100 |

# 5 Table of User Communities, Data Stores, Network Applications and Traffic Flows

The user communities for Prestige Auto Mart’s (PAM) network includes Employee at the headquarters and branch offices, corporate customers, individual customers etc. Inventory records for new and used vehicles, client information such as contact details, sales records, and financial transactions are all stored on the network servers. PAM’s customized software for vehicle reservations and orders, on-site payment facilities, a customer online web portal, a mobile app, and a CCTV system with remote monitoring are among the various network applications. The network traffic, its flow and management include Customers making orders through the web portal or mobile app which updates inventory data in real-time, vehicle reservation orders being processed by PAM’s proprietary software, and deliveries being made to customers etc. The traffic flow also includes the secure transfer of customer and financial data, as well as the integration of a cloud-based server and IPv6 addresses for improved security and performance.

## 5.1 User Communities

There are different users using the PAM’s network on daily basis through wired and wireless connection. Number of users per day is based on the assumption made earlier.

Table 3: User communities in PAM’s network

|  |  |  |  |
| --- | --- | --- | --- |
| User Community Name | Size per Day (Number of Users) | Location | Applications |
| Customers | 1200 | Melbourne  Sydney  Brisbane  Perth  Darwin  Hobart | Online Web Portal  Mobile Application  Email  Payment System |
| Staff | 90 | Melbourne  Sydney  Brisbane  Perth  Darwin  Hobart | Email  Proprietary Software  Database  CCTV |
| Delivery Driver | 30 | Melbourne  Sydney  Brisbane  Perth  Darwin  Hobart | Distribution Mobile App  Email  GPS |
| IT Department | 10 | Melbourne | Database  Servers  Propitiatory Software  Email  CCTV  Network |

## 5.2 Data Stores

The data generated or consumed while using PAM’s network is being stored in different data stores in which some of them are in all branches while majority of servers located at the head office.

Table 4: Showing data stores in relation with location, applications and user communities.

|  |  |  |  |
| --- | --- | --- | --- |
| Data Store | Location | Applications | User Communities |
| Proprietary Software Database | All Branches | Propitiatory Software | Sales Team  IT Department |
| CCTV Database | All Branches | CCTV App | Sales Team  IT Department |
| Web Server | Melbourne | Internet Browser | Customers  Sales Team  IT Department |
| Mobile Application Server | Melbourne | Mobile App | Customers  Sales Team  IT Department  Delivery Drivers |
| Payment Gateway | Melbourne | Web Server | Customers  IT Department |
| Email Server | Melbourne | Email App  Internet Browser | Customers  Sales Team  IT Department  Delivery Drivers |
| SSH Server | Melbourne | Linux | IT Department |

## 5.3 Network Applications

The applications run in the PAM’s network using various protocols, the requirement of bandwidth differ from application to application which is shown in table below:

Table 5: Application run in PAM’s network and their protocols

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Name of Application | Type of Traffic Flow | Protocol Used by Application | User Communities | Data Stores | Required Bandwidth | QoS Requirements |
| Web Portal | Client- Server | HTTP/HTTPS | Customers  Staffs | Web Server | Moderate to High | Low Latency  High Availability  Secure Connection |
| Mobile App | Client- Server | HTTP/HTTPS | Customers  Delivery Drivers | Mobile App Server | Moderate to High | Low Latency  High Availability  Secure Connection |
| Proprietary Software | Client-Server | Custom Protocol | Staff  IT Department | Software Database | Moderate to High | Low Latency  High Availability  Secure Connection |
| Payment System | Client-Server | HTTPS  Secured Electronic Transaction (SET) | Customer | Customer  Database  Payment Gateway | High | Low Latency  Secure Connection |
| Network Management | Management Traffic | SNMP  SSH | IT Department | Network Devices | Low to Moderate | Low latency  Monitoring & Configuration |

## 5.4 Traffic Flows

The traffic flows while using different application requires different data speed according to the application type and data it consumes.

Table 6: Traffic flow with data speed

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| User Communities | Data Stores | Network Applications | Traffic Flows | Data Speed |
| Customers | Vehicle inventory | Online web portal | Web traffic  (HTTP/HTTPS) | 50 Kbps |
|  | Customer orders | Mobile app | Mobile app traffic | 100 Kbps |
|  | Payment information | PAM Proprietary software | Proprietary software traffic | 100 Kbps |
|  |  | Email server | Email traffic  (SMTP/POP/IMAP) | 20 Kbps |
| Sales Staff | Customer details | Proprietary software | Proprietary software traffic | 100 Kbps |
|  | Vehicle inventory | Showroom application | Showroom application traffic | 100 Kbps |
|  | Sales data | Business application | Application traffic | 50 Kbps |
|  |  | Email server | Email traffic  (SMTP/POP/IMAP) | 20 Kbps |
| Delivery drivers | Vehicle inventory | Distribution truck application | Distribution truck application traffic | 100 Kbps |
|  | Customer orders | Mobile app | Mobile app traffic | 100 Kbps |
|  | Delivery details | GPS tracking application | GPS tracking application traffic | 250 Kbps |
|  |  | Email server | Email traffic  (SMTP/POP/IMAP) | 20 Kbps |

# 6 Addressing and Naming

The addressing and naming strategy for PAM's Network should be designed in such a way that it recognizes various devices and applications on the network and supports inter-communication. [The domain name system (DNS) should be used to provide naming and address resolution for devices and services on the PAM network (Musiani, 2022).](https://learn.saylor.org/mod/page/view.php?id=27475) To accomplish this, a hierarchical addressing mechanism based on IP addresses and domain names should be utilized. The IP address system should be designed to accommodate the network's size as well as any future development scenarios (Author *et al.*, no date). So, Communication between internal devices is incorporated with Private IP addresses while for external communication with other networks, Public IP addresses are used.

Moreover, A naming convention for network devices and services should be developed in addition to IP addressing and domain name. This approach will help in the efficient management of network servers and the resources associated with them. This standard should be designed to make the identification of network devices and services as straightforward as possible, and it should be comparable across all sites.

DHCP (Dynamic Host Configuration Protocol) is used to as it allows each end system to learn its address automatically and it is feasible with both ipv4 and ipv6.

The IP addressing of different branches is given below:

Table 7: IP addressing for all offices and servers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Branch | CIDR | Network address | Broadcast address | Usable address |
| Melbourne head office | 10.1.0.0/25 | 10.1.0.0 | 10.1.0.127 | 10.1.0.1-10.1.0.126 |
| Sydney office | 10.2.0.0/25 | 10.2.0.0 | 10.2.0.127 | 10.2.0.1-10.2.0.126 |
| Brisbane office | 10.3.0.0/25 | 10.3.0.0 | 10.3.0.127 | 10.3.0.1-10.3.0.126 |
| Perth office | 10.4.0.0/25 | 10.4.0.0 | 10.4.0.127 | 10.4.0.1-10.4.0.126 |
| Darwin office | 10.5.0.0/25 | 10.5.0.0 | 10.5.0.127 | 10.5.0.1-10.5.0.126 |
| Hobart office | 10.6.0.0/25 | 10.6.0.0 | 10.6.0.127 | 10.6.0.1-10.6.0.126 |
| Web servers | 10.10.0.0/25 | 10.10.0.0 | 10.10.0.127 | 10.10.0.1-10.10.0.126 |
| Application servers | 10.20.0.0/25 | 10.20.0.0 | 10.20.0.127 | 10.20.0.1-10.20.0.126 |
| Database servers | 10.30.0.0/25 | 10.30.0.0 | 10.30.0.127 | 10.30.0.1-10.30.0.126 |

As far the naming concern for devices or location, three uppercase letter is chosen to make it short, meaningful, and distinct. Here is the list of naming for devices and locations:

Table 8: Naming convention for PAM’s network

|  |  |
| --- | --- |
| Device / location | Names |
| Router | RTR |
| Switch | SWC |
| Server | SRV |
| Application | APP |
| Computer | CMP |
| Mobile | MOB |
| Printer | PRT |
| Firewall | FWR |
| Camera | CAM |
| Melbourne | MEL |
| Sydney | SYD |
| Brisbane | BNE |
| Perth | PTH |
| Darwin | DRW |
| Hobart | HOB |

# 7 Explanation and Justification of Logical Network Design

The logical network design for Prestige Auto Mart (PAM) will be based on a hierarchical topology with a core, distribution, and access layer throughout the hierarchy (Wang *et al.*, 2017). The core layer will be responsible for high-speed interconnectivity between the distribution layers in the branch office, as well as the head office in Melbourne. WAN connection is used to connect multiple branches. The distribution layer will provide access to network services and segment the network into smaller sections of broadcast domains. The access layer will connect end-user devices to the network and provide access to various network resources.

Each branch office will have its individual LAN, with a switch acting as the distribution layer in the middle and providing connectivity to the core layer through a high-speed link.Access layer switches will provide connectivity to end-user devices, such as desktops, laptops, cameras, and mobile devices, as well as printers and other network devices. For limited budget, there will be limited number of networking devices such as routers, switches whereas for unlimited budget, multiple networking devices is proposed to ensure redundancy and traffic control. For example, there are 2 physical routers, and one VPN router is proposed for branch offices in which all the switches are connected with them. If one router is unable to perform or higher in traffic flow, connection is still established via other router enabling successful operation.

The head office will house the data centre along with servers and storage to support the centralized services required by PAM. These services include the web server, email server, reservation system, the inventory database, and the customer relationship management system. [The data centre will be connected to the core layer and will be replicated in all branch offices for redundancy processing as well as recovery after events of disaster.](https://learn.microsoft.com/en-us/azure/storage/common/storage-introduction)

The logical network design will also take into consideration the security requirements of PAM.The appropriate security mechanisms such as firewalls, intrusion detection and prevention systems (IDPS), and virtual private networks (VPNs) ensure the confidentiality, integrity, and availability of PAM’s data and network resources.

# 8 Logical Network Diagrams including Addressing and Naming

The logical network diagrams for Prestige Auto Mart's (PAM) network design will show the layout/representation of network devices as well as how they will be connected. Addressing and naming conventions for all network devices and interfaces are included in the diagrams.

The main office in Melbourne will require a core switch and a router to connect to the internet service provider (ISP) and to other branch offices. Each branch office will have its own switch, router, and wireless access points. In addition, each showroom will have its own switch and access points (Waldring, 2009).

The web server and database server will be hosted in a data centre in Melbourne, with [cloud-based servers used for redundancy and scalability](https://www.lucidchart.com/blog/reliability-availability-in-cloud-computing). [The payment gateway and inventory management software will be hosted side by side on the same server in the data centre](https://www.techtarget.com/searchdatacenter/definition/data-center).The network should be designed with redundancy consideration so that even if the server or device fails, the network can continue to function with minimal downtime.

The network diagrams should also illustrate traffic flows in the network, including customer orders and payments, inventory management, and remote monitoring of showrooms through CCTV cameras.The use of Quality of Service (QoS) mechanisms should be considered to prioritize traffic for critical applications, such as the inventory management software and payment gateway.

## 8.1 Limited Budget

### 8.1.1 Network Connection between All Branch Offices

A picture containing diagram, screenshot, text, design

Description automatically generated

Figure 1: WAN connection between all branches using internet (logical diagram – limited budget)

### 8.1.2 LAN Connection of Head Office

A diagram of a computer network

Description automatically generated with low confidence

Figure 2: LAN connection of head office (logical diagram – limited budget)

### 8.1.3 LAN Connection of Each Branch Office

A screenshot of a video game

Description automatically generated with medium confidence

Figure 3: LAN connection of branch offices (logical diagram – limited budget)

## 8.2 Unlimited Budget

### 8.2.1 Network Connection between All Branch Offices

A screenshot of a computer

Description automatically generated with low confidence

Figure 4: WAN connection between all branches using SDH (logical diagram – unlimited budget)

### 8.2.2 LAN Connection of Head Office

A screenshot of a computer

Description automatically generated with medium confidence

Figure 5: LAN connection of head office (logical diagram – unlimited budget

### 8.2.3 LAN Connection of Each Branch Office

A screenshot of a computer

Description automatically generated with medium confidence

Figure6: LAN connection of branch office (logical diagram – unlimited budget)

# 9 List of Routing and Switching Protocols, and Security Mechanisms

The routing and switching protocols used in the network design must be selected while considering the technical goals and constraints identified for this project. In this context, the network supports many users and high-volume data traffic, so efficient routing and switching protocols are necessary. Protocol selection must take into account the compatibility of existing equipment, scalability, and ease of management (Ahmed and Abadin, 2021).

For unlimited budget, we have chosen [recommended dynamic routing protocols such as OSPF or EIGRP for efficient traffic routing, as well as VLANs for logical network segmentation](https://www.comparitech.com/net-admin/routing-protocol-types-guide/).Additionally, for switching protocols, the project should implement the Spanning Tree Protocol (STP) or Rapid Spanning Tree Protocol (RSTP) for loop avoidance as well as Link Aggregation Control Protocol (LACP) for improved bandwidth utilization. In case of minimum budget, we have used RIP (Router Information Protocol) switching protocol is used as it is simple, easy to configure and does not require much processing power.

# 10 Physical Network Diagram

The physical diagram of PAM’s network follows the same logical network diagrams with more detail of devices used and connection made. For limited budget, low-cost devices and technologies are used whereas for unlimited budget multiple connections and high-cost devices has been used to ensure high availability and security. While selecting cables for data transmission, cat 6 ethernet is used within each office in limited budget whereas fibre connection is for unlimited budget. Necessary naming and IP addressing is presented in each diagram to provide enough information of physical diagrams.

WAN technology is being used to connect multiple branches. Internet is used for limited budget whereas Sonet SDH is used for unlimited budget. The connection is single line in limited option while point to multipoint connection in unlimited budget provide much higher traffic flow and redundancy.

## 10.1 Limited Budget

## 10.1.1 Network Connection between All Branch Offices

A picture containing screenshot, circle, art

Description automatically generated

Figure 7: WAN connection between all branches using internet (physical diagram – limited budget

### 10.1.2 LAN Connection of Head Office

A picture containing diagram, text

Description automatically generated

Figure 8: LAN connection of headquarter (physical diagram – limited budget)

### 10.1.3 LAN Connection of Each Branch Office

A screenshot of a computer

Description automatically generated with low confidence

Figure 9: LAN connection of branch office (physical diagram – limited budget)

## 10.2 Unlimited Budget

### 10.2.1 Network Connection between All Branch Offices

A screenshot of a video game

Description automatically generated with medium confidence

Figure 10: WAN connection between all branches using SDH (physical diagram – unlimited budget)

### 10.2.2 LAN Connection of Head Office

A screenshot of a computer game

Description automatically generated with medium confidence

Figure 11: LAN connection of Headquarter (physical diagram – unlimited budget)

### 10.2.3 LAN Connection of Each Branch Office

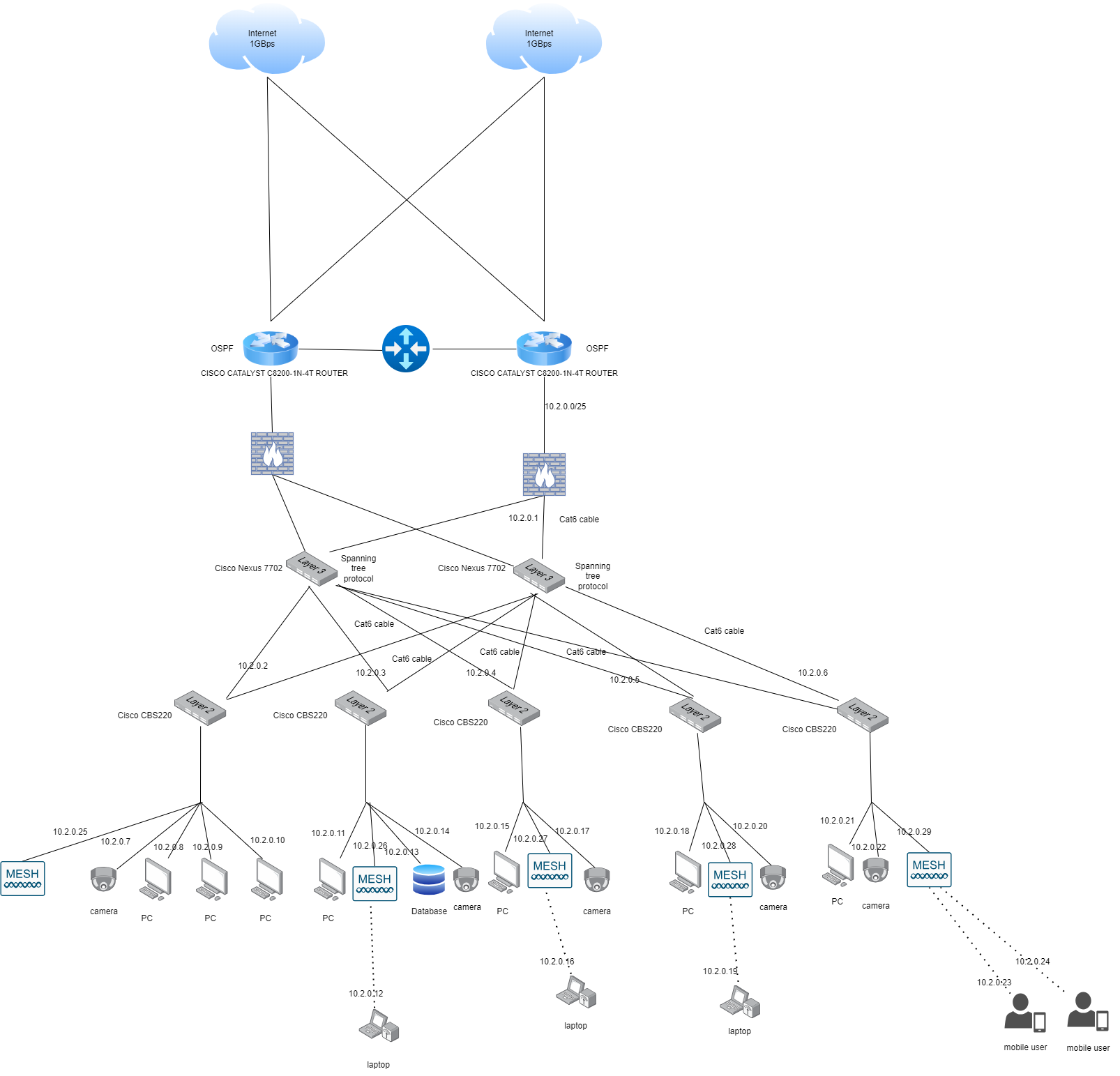


Figure 12: LAN connection of branch office (physical diagram – unlimited budget)

# 11 Networking and Communication Devices and Applications Required

Whole network design consists of networking and communication devices such as router, switch, cables, internet connection. Also, network management application plays vital role while managing such complex network.

## 11.1 Limited budget devices and applications

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S. N | Product name | Product number | IP address allocated | Approximated price |
| 1. | 100 Mbps Internet | NBN™  Enterprise Ethernet | - | $299 per month |
| 2. | VPN router | Cisco RV260 | 10.2.0.0/25 | $349 per device |
| 3. | Cable | Cat6 | - | $2 per metre |
| 4. | Switch (Layer 3) | S5850-24S2Q | 10.2.0.1 | $2,430 per device |
| 5. | Switch (Layer 2) | Cisco CBS220-24FP-4X-AU | 10.2.0.2 | $1750 per device |

## 11.2 Unlimited budget devices and application

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S.N. | Product name | Product number | Ip address allocated | Approximated price |
| 1. | SONET SDH | - | Provided by TPG | $100,000 per year |
| 2. | 1GBps internet speed | Fibre1000 | Provided by TPG | $800 per month |
| 3. | Cisco Catalyst C8200-1N-4T Router. | C8200-1N-4T | 10.1.0.0/25 | $8174.61 per device |
| 4. | Cisco Nexus 7702-layer 3 switch | N77-C7702 | 10.1.0.1 | $17,400 per device |
| 5. | Cisco CBS220 – layer 2 switch | CBS220-24FP-4X | 10.1.0.2 | $1750 per device |
| 6. | Fibre Optic cable | Optical fibre 2 core | - | $7 per meter |
| 7. | Ninja One network management software | ninjaone | - | $130 per month |

# 12 Explanation and Justification of Networking and Communication Devices and Applications

## 12.1. Limited Budget

A 100 Mbps TPG Internet connection is incorporated into the network design as a cost-effective solution for tight financial limitations. This bandwidth is enough for supporting Prestige Auto Mart's activities, including order processing, data transfer between offices, and online client interactions.

As the main network gateway, the Cisco RV260 router was chosen because of its low cost and capacity to manage Internet connections. For the safety of PAM's patented algorithm and user data, it provides cutting-edge security features like firewall and VPN support. Additionally, the router offers routeing features for effective data flow within the network.

Cat6 cables are preferred since they are less expensive and operate with existing network infrastructure. They provide for up to 1 Gbps of support and high-speed data transmission, future-proofing the network against future improvements.

The S5850-24S2Q switch is used as a layer 3 switch at the network's core. It provides cutting-edge routing capabilities to ensure smooth and effective network traffic flow. The switch also supports features like Quality of Service (QoS) for prioritising network traffic and offers scalability for future growth.

To link the end devices and provide Power over Ethernet (PoE) capabilities for IP cameras and other devices, the Cisco CBS220-24FP-4X-AU switch is used as a layer 2 switch. This switch provides sufficient port density and affordable PoE support to meet the needs of the network.

Overall, this network configuration, which complies with Prestige Auto Mart's specifications, makes use of a 100 Mbps Internet connection, a Cisco RV260 router, Cat6 cables, an S5850-24S2Q switch, and a Cisco CBS220-24FP-4X-AU switch. For their operations, it offers dependable connectivity, security features, and scalability while minimising expenses.

## 12.2. Unlimited Budget

The SONET SDH technology used in the network design offers Prestige Auto Mart's network infrastructure a highly dependable and scalable solution. Because SONET SDH guarantees reliable and fault-tolerant connectivity, it is appropriate for crucial business processes.

A TPG high-speed 1 Gbps Internet connection is incorporated into the network design, allowing for quick and effective data transfer between locations. The demands of PAM's online web portal, client orders, and real-time data synchronisation are supported by this additional capacity.

The major network gateway is the Cisco Catalyst C8200-1N-4T Router due to its high-performance capabilities and sophisticated security features. To ensure optimal data flow throughout the network, it offers efficient routeing and can handle 1 Gbps Internet speed. Additionally, the router provides thorough security mechanisms that guard against unauthorised access to both PAM's unique algorithm and customer data.

The layer 3 switch is the Cisco Nexus 7702, which offers improved performance, scalability, and flexibility. A smooth extension and room for future growth are made possible by its high port density and modular architecture. Additionally, the switch supports cutting-edge technologies like Quality of Service (QoS), which prioritises network traffic and enhances network performance.

The layer 2 switch is a Cisco CBS220-24FP-4X-AU switch, which has enough port density and Power over Ethernet (PoE) capabilities. This switch enables reliable and efficient data transmission while supporting the connecting of end devices like IP cameras and access points.

Fibre optic cables are used because of their ability to transmit data across great distances and have a high bandwidth capacity. They minimise latency and preserve network performance by ensuring quick and dependable data flow between locations.

For thorough monitoring, setup, and troubleshooting capabilities, Ninja One network management software is used. It provides network administration that is centralised, streamlining network operations, and assuring effective maintenance.

With SONET SDH, 1 Gbps Internet speed, Cisco Catalyst C8200-1N-4T Router, Cisco Nexus 7702, Cisco CBS220-24FP-4X-AU Switch, fibre optic connections, and Ninja One network management software, this network design provides a reliable and scalable solution without regard to cost. For PAM's network infrastructure, it ensures excellent availability, performance, and security.

# 13 Test Plan

## 13.1. Test plan for limited budget

1. Application Response-Time Testing: Check the network-accessible important applications' response times, such as the system for processing customer orders and the online web portal. Measure how long it takes for various tasks, such as ordering, retrieving data, and loading pages. To achieve the best application performance, compare the reaction times against predetermined benchmarks or industry standards.
2. Throughput testing: To evaluate the speed at which data is transferred between devices, measure the network throughput using software like Speedtest. To assess the network's capacity to manage peak loads, run testing throughout the day. Check to see if the Cat6 cables, network devices, and 100 Mbps Internet connection can offer the desired throughput rates.
3. Availability testing: To evaluate the network design's availability and resilience, simulate network breakdowns or disturbances. Keep an eye on the network's capacity to recover connectivity and functionality as well as the recovery time. To ensure seamless network operation, examine the failover capabilities of the Cisco RV260 router and S5850-24S2Q switch.
4. Regression testing: Regression testing should be done after any network configuration updates or changes to ensure that no functionality has been impacted. Verify the network design's stability and compatibility with the current systems and applications. To verify their continuous functionality, test important network services and protocols like DHCP, DNS, and VLAN setups.
5. Security testing: To assess the performance of established security measures, such as firewall rules and access controls, conduct security testing. To find potential security gaps and vulnerabilities, conduct penetration tests and vulnerability assessments.

## 13.2. Test plan for unlimited budget

1. Application response-time testing: To provide the best user experience, track the response times of crucial programs like the order processing system and online web portal. Analyze how long it takes to complete various tasks, such as retrieving data and processing transactions, and page loads. In comparison to predetermined benchmarks or industry norms, compare the reaction times.
2. Throughput testing: To evaluate the speed at which data is transferred between devices, measure network throughput using programs like Speedtest. Tests should be run throughout the day to assess network performance during peak demands. Check to see if the network equipment, fiber optic cables, and 1 Gbps Internet speed can deliver the desired throughput levels.
3. Availability testing: To evaluate the robustness and availability of the network design, simulate network failures or disruptions. Keep an eye on the network's capacity to recover connectivity and functionality as well as the recovery time. To ensure smooth operation, analyze the failover features of the Cisco Catalyst C8200-1N-4T Router and Cisco Nexus 7702.
4. Regression testing: Regression testing should be done after any network configuration updates or changes to ensure that current functioning is not impacted. Verify the network design's stability and compatibility with the current systems and applications. To ensure continuing functionality, test important network services and protocols like DHCP, DNS, and VLAN configurations.
5. Security testing: To assess the success of established security measures, such as firewall rules, access controls, and intrusion detection systems, conduct security testing. To find potential security gaps and vulnerabilities, conduct penetration tests and vulnerability assessments.

# 14 Detailed Test Scrip for the Test Plan

**Test Scenario: Application Response time testing**

Objective: to measure the response time of the critical application

Step1: Start up the essential programmes, including the order processing system and online web portal.

Step2: Carry out routine tasks like logging in, looking through the product catalogue, and placing an order.

Step 3: Use a timer or a network monitoring tool to time the duration of each activity.

Step 4: Repetition of procedures step 2 and step 3 for users accessing the applications simultaneously.

**Test Scenario: Throughput testing**

Objective: To measure the network throughput between devices

Step 1: Pick two network-connected devices.

Step 2: Calculate the data transfer rate between the devices using a programme like Speedtest.

Step 3: Repeat the test multiple times throughout the day to assess network performance under heavy usage.

**Test Scenario: Availability testing**

Objective: To measure the availability of the network

Step 1: By cutting a wire or turning off a network device, we can simulate a network failure.

Step 2: Track how long it takes the network to recover and re-establish connectivity.

Step 3: After the recovery, ensure that all essential network services and applications are operational.

**Test Scenario: Regression testing**

Objective: To ensure that the existing functionality is unaffected

Step 1: Examine the network services and applications that are currently in use.

Step 2: Verify that all functions that were previously functional are still functioning as expected.

Step 3: Examine network installations and protocols, such as DHCP, DNS, and VLAN settings.

# References:

Ahmed, M. and Abadin, A.F.M., 2021. ‘A Comprehensive Study and Analysis of Different Routing Protocols for Enterprise LAN’, International Journal of Business Innovation and Research, 5, pp. 20–28. Available at: <https://doi.org/10.5281/zenodo.4736649>

Musiani, F., 2022. ‘Decentralizing DNS: Peers, Infrastructure, and Internet Governance on JSTOR’. Available at: <https://www.jstor.org/stable/43134327> (Accessed: 24 April 2023). Panahi, M., Nie, W. and Lin, K.-J. 2009

The Design and Implementation of Service Reservations in Real-Time SOA. Available at: <https://doi.org/10.1109/ICEBE.2009.26>. Stocchi, L. et al. 2022. ‘Marketing research on Mobile apps: past, present and future.’, Journal of the Academy of Marketing Science, 50(2), pp. 195–225. Available at: <https://doi.org/10.1007/s11747-021-00815-w>

V L, P., 2018. ‘A Novel Authentication Mechanism to Prevent Unauthorized Service Access for Mobile Device in Distributed Network’, International Journal of Interactive Mobile Technologies (iJIM), 12. Available at: <https://doi.org/10.3991/ijim.v12i8.8194>

Waldring, S.J., 2009. ‘Standard Network Diagramming Language and Corresponding Meta-Model’. Available at: <https://digitalcommons.georgiasouthern.edu/etd> (Accessed: 24 April 2023)

Wang, C. et al. 2017. ‘A hierarchical network model for network topology design using genetic algorithm’, MATEC Web of Conferences, 119, p. 1008. Available at: <https://doi.org/10.1051/matecconf/201711901008>