Jaden Maciel

Networking Project

CYBR-2500-02

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Executive Summary

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This final project is the completion and understanding of my learning for the CYBR-2500 course in Data Networking and Communications. As a Software Development major with minors in Computer Science and Business Management. I have created this network to benefit both academically and professionally as an aspiring Software Engineer. My dream network must support a broad variety of development workflows, from web and mobile application development to software testing, version control, and later on deployment to the cloud with a high-level security, performance, and reliability.

To support this network I've envisioned of, I've included high-performance Linux, Windows and macOS machines to simulate real-world development environments. Alongside with tools that will enable efficient remote coding, debugging, and deployment. Security is always a priority, with configuration settings that protect codebases and projects. This setup will not only reflect my technical knowledge but also conveys the multi-platform, hybrid environments commonly used in professional software engineering settings.

Item Catalog

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Name	(Windows Low-End Desktop) Dell OptiPlex 7010 Micro
Diagram Code	A1
Specs	**Processor** Intel® Core™ i5 14500T vPro® (24MB cache, 14 cores, 20 threads, up to 4.8 GHz) **Operating System** Windows 11 Pro, English, Brazilian Portuguese, French, Spanish **Memory** 16 GB: 1 x 16 GB, DDR5 **Storage** M.2 2230 512GB PCIe NVMe SSD Class 35 **Additional Storage** No Additional Hard Drive **Wireless** No Wireless LAN Card **Wireless Driver** None **Chassis Options** OptiPlex Micro with 35W CPU
Price	$959.00
Where to Buy?	Dell OptiPlex Micro From Factor | Dell USA

Name	(Windows High-End Desktop) Alienware Aurora R16

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Diagram Code	A2
Specs	**Processor** Intel® Core™ Ultra 9 processor 285K (24-Core, 76MB Total Cache, 3.7GHz to 5.7GHz) **Operating System** Windows 11 Home **Graphics** NVIDIA® GeForce RTX™ 5080 16GB GDDR7 **Memory** 64GB Dual Channel DDR5 (2x 32GB - Green) 5200 MT/s **Storage** 2TB NVMe M.2 PCIe SSD **Chassis Options** 1000W Platinum Rated PSU, 240mm Liquid-Cooled CPU & Clear Side Panel **Wireless** Intel Wi-Fi 7 BE200 (2x2) 802.11ax Wireless LAN and Bluetooth **Cooling Option** Top fan not required
Price	$3,349.99
Where to Buy?	Alienware R16 Gaming Desktop with Air Cooling & Liquid Cooling | Dell USA

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Name	(Linux Desktop) Precision 5860 Tower Workstation
Diagram Code	B1
Specs	**Precision 5860 Tower** Precision 5860 Tower XCTO Base **Processor** Intel® Xeon® W5-2465X (16 cores, up to 4.7 GHz Turbo, 200 W) **Operating System** Ubuntu® Linux® 22.04 **System Management** Intel® vPro Technology Enabled **Memory** 64 GB: 4 x 16 GB, DDR5, 4800 MT/s, RDIMM, ECC **Graphics Card** Nvidia RTX A400, 4GB GDDR6, 4 mDP to DP **Storage Configuration (Boot Drive and Flexbay)** [C1] Internal M.2 SSD Boot with Dual SATA Flexbay **Storage Controllers** Integrated Storage Controller
Price	$5,344.35
Where to buy?	Precision 5860 Tower Workstation | Dell USA

Name	(macOS Desktop) Mac Studio (M3 Ultra)

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Diagram Code	B2
Specs	**Hardware** • Apple M3 Ultra chip with 28-core CPU, 60-core GPU, 32-core Neural Engine • 96GB unified memory • 1TB SSD storage • Front: Two Thunderbolt 5 ports, SDXC card slot • Back: Four Thunderbolt 5 ports, two USB-A ports, HDMI port, 10Gb Ethernet port, headphone jack • Accessory Kit **Software** • Photos, iMovie, GarageBand • Pages, Numbers, Keynote • macOS
Price	$3,999.00
Where to Buy?	Mac Studio (M3 Ultra) | Apple

Name	(Windows Low-End Laptop) Dell Inspiron 14
Diagram Code	A3

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Specs	**Base** Inspiron 14 5440 **Processor** Intel® Core™ 7 150U (10 cores, up to 5.4 GHz) **Operating System** Windows 11 Home, English, French, Spanish **Memory** 16 GB: 2 x 8 GB, DDR5, 5200 MT/s **Storage** 1 TB, M.2, PCIe NVMe, SSD **Display** 14", Non-Touch, FHD+ 1920x1200, 60Hz, WVA, IPS, Anti-Glare, 250 nit, ComfortView **FGA Module** 2500_2005/US/BTS **Color** Ice Blue Metal Cover
Price	$699.99
Where to Buy?	Inspiron 14 Laptop | Dell USA

Name	(Windows High-End Laptop) Dell XPS 13
Diagram Code	A4

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Specs	**Base** XPS 13 9350 **Processor** Intel® Core™ Ultra 7 processor 256V Series 2 (12MB Cache, 8 cores, up to 4.8 GHz) **Operating System** Windows 11 Pro, Copilot+ PC **Graphics** Intel® Arc™ graphics **Memory** 16GB, LPDDR5X, 8533MT/s, integrated **Display** 13.4", Non-Touch, FHD+ 1920x1200, 30-120Hz, Anti-Glare, 500 nit, Eyesafe®, InfinityEdge **Storage** 512GB M.2 PCIe NVMe Solid State Drive **Wireless** Intel® Killer™ Wi-Fi 7 1750i (BE201) 2x2 + Bluetooth 5.4 Wireless Card
Price	$1,459.99
Where to buy?	New XPS 13 Laptop | Dell USA

Name	(macOS Laptop) MacBook Pro 16” (M4 Max)
Diagram Code	B3

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Specs	**Hardware** • 16-inch Liquid Retina XDR display² • Standard display • Apple M4 Max chip with 16-core CPU, 40-core GPU, 16-core Neural Engine • 48GB unified memory • 1TB SSD storage • 140W USB-C Power Adapter • Three Thunderbolt 5 ports, HDMI port, SDXC card slot, headphone jack, MagSafe 3 port • Backlit Magic Keyboard with Touch ID - US English • Accessory Kit **Software** • Photos, iMovie, GarageBand • Pages, Numbers, Keynote • macOS
Price	$3,999.00
Where to buy?	16-inch MacBook Pro | Apple

Name	(Smartphone) iPhone 16 Pro 1TB Black

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Diagram Code	M1
Specs	A18 Pro chip with 6-core GPU, 1TB Storage, 6.3″ Super Retina XDR display, ProMotion technology
Price	$1,499.00
Where to buy?	iPhone 16 Pro | Apple

Name	(Tablet) iPad Pro 13”
Diagram Code	M2
Specs	M4 Chip, 1TB Storage, 13” Ultra Retina XDR display, ProMotion technology
Price	$1,899.00
Where to Buy?	iPad Pro | Apple

Name	(Printer) Brother Color MFC-L8900CDW
Diagram Code	B4

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<table>
<tr><td>Specs</td><td>
<table>
<tr><td colspan="2">Printer Type</td><td>• Laser</td></tr>
<tr><td colspan="2">Print Method</td><td>• Electrophotographic Laser Printer</td></tr>
<tr><td>Memory Capacity</td><td>Standard</td><td>• (MFC-L8610CDW/MFC-L8900CDW/MFC-L8895CDW/MFC-L8905CDW)
512 MB</td></tr>
<tr><td colspan="2">LCD (Liquid Crystal Display)</td><td>• (MFC-L8610CDW)
3.7 in. (93.4 mm) TFT Color touchscreen LCD *1
• (MFC-L8900CDW/MFC-L8895CDW)
5.0 in. (125.9 mm) TFT Color touchscreen LCD *1
• (MFC-L8905CDW)
7.0 in. (176.1 mm) TFT Color touchscreen LCD *1</td></tr>
<tr><td colspan="2">Power Source</td><td>• 110 to 120 V AC 50/60 Hz</td></tr>
<tr><td rowspan="9">Power Consumption
(Average)</td><td>Peak</td><td>• Approximately 1230 W</td></tr>
<tr><td>Printing *2</td><td>• Approximately 600 W at 77°F (25°C)</td></tr>
<tr><td>Printing
(Quiet Mode) *2</td><td>• Approximately 360 W at 77°F (25°C)</td></tr>
<tr><td>Copying *2</td><td>• Approximately 600 W at 77°F (25°C)</td></tr>
<tr><td>Copying
(Quiet Mode) *2</td><td>• Approximately 370 W at 77°F (25°C)</td></tr>
<tr><td>Ready *2</td><td>• Approximately 75 W at 77°F (25°C)</td></tr>
<tr><td>Sleep *2</td><td>• Approximately 9.5 W</td></tr>
<tr><td>Deep Sleep *2</td><td>• (MFC-L8610CDW)
Approximately 1.5 W
• (MFC-L8900CDW/MFC-L8895CDW/MFC-L8905CDW)
Approximately 1.7 W</td></tr>
<tr><td>Power Off *2 *3 *4</td><td>• Approximately 0.02 W</td></tr>
</table>
</td></tr>
<tr><td>Price</td><td>$649.99</td></tr>
<tr><td>Where
to buy?</td><td>Brother Color MFC-L8900CDW | Amazon</td></tr>
</table>

Name	(Switch) 8-Port Gigabit Ethernet Unmanaged PoE+ Essentials Switch with 8-Ports PoE+ (83W) (x2)

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Diagram Code	C1

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Specs	
	Model Name : NETGEAR 8-Port Gigabit Ethernet Unmanaged PoE+ Essentials Switch with 8-Ports PoE+ (83W) **Model :** GS308PP **Speed :** Gigabit **Number of Ports :** 8 **PoE ports :** 8 PoE+ @ 25.5W each until budget is met. **PoE budget :** Up to 83W Total (Upgradable to 123W with optional PSU) **Energy Efficient Ethernet support :** Yes - Compliant with IEEE802.3az Energy Efficient Ethernet mode **Jumbo frame support :** 9,216 bytes **MAC table size :** 4K **Packet buffer size :** 192k **PoE Auto balance :** Yes - Balances the PoE power per port based on the device needs independent of PoE class detected **Optional Modules and Accessories :** EPS90W 90W External Power Adapter (Included) EPS130W 130W External Power Adapter (Optional, up to 123W PoE+ Budget) **Protocols :** IEEE 802.3ab 1000BASE-T Gigabit Ethernet IEEE 802.3u 100BASE-TX Fast Ethernet IEEE 802.3i 10BASE-T Ethernet

	IEEE 802.3x Flow Control IEEE 802.1p Priority QoS (all models) IEEE 802.3 CSMA/CD 802.3az Energy Efficient Ethernet
Price	Unit: $129.99 Total: $259.98
Where to Buy?	8-Port Gigabit Ethernet Unmanaged PoE+ Essentials Switch with 8-Ports PoE+ (83W) | NETGEAR

Name	(Router/AP) SXK30 — Orbi Pro WiFi 6 Mini AX1800 WiFi System
Diagram Code	C2

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Specs	**Technical Specifications**
	• Orbi Pro WiFi 6 Mini Dual-band AX1800 Router and WiFi 6 Mini Dual-band AX1800 Satellite (1,200 + 600) Mbps†
	• Simultaneous Dual-band WiFi
	  • Radio 1: IEEE 802.11b/g/n/ax 2.4GHz - 256QAM support
	  • Radio 2: IEEE 802.11a/n/ac/ax 5GHz - 1024QAM support
	• Two (2) high-performance antennas with high-power amplifiers each
	• Explicit Beamforming for 2.4GHz and 5GHz bands
	• Integrated Gigabit Smart Ethernet Switch for business grade security and applications
	  • 802.1Q VLAN
	  • Access Control
	• MU-MIMO capable for simultaneous data streaming on multiple devices
	• Ethernet Ports – Orbi Pro WiFi 6 Mini Router
	  • One (1) Gigabit Ethernet WAN port
	  • Three (3) Gigabit Ethernet LAN ports
	• Ethernet Ports – Orbi Pro WiFi 6 Mini Satellite
	  • Four (4) Gigabit Ethernet LAN ports
	• Security
	  • Four (4) SSID wireless networks
	  - Aministration devices
	  - Employee devices
	  - Guest devices with Captive Portal Challenge
	  - IoT devices
	  • Guest WiFi Network is easy to setup for secure Internet access
	  • Guest network devices are denied access to Administrative Network devices
	  • WPA/WPA2-PSK/WPA3-PSK support
	  • WPA-Enterprise
	  • Supports wireless and wired VLAN

Price	$299.99
Where to Buy?	Orbi Pro WiFi 6 Mini System, 2-Pack AX1800 (SXK30) | NETGEAR

Name	(MODEM) SURFboard S33 DOCSIS 3.1 Cable

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Diagram Code	C3
Specs	**S33 SURFboard Technical Specifications** **Compatibility** — Major U.S. Cable Providers **Download Speed (Internet)** — Up to 3.5 Gbps **DOCSIS** — 3.1 **Gigabit Ethernet Port** — One 2.5 Gb Ethernet port and one 1 Gb Ethernet port **Wi-Fi** — No **HD Multi-Media Streaming** — Yes **High-Performance Online Gaming** — Yes **Energy-Efficient Ethernet** — Yes **Telephone Port** — None
Price	$199.00
Where to Buy?	SURFboard S33 DOCSIS 3.1 Cable Modem | SURFboard Store

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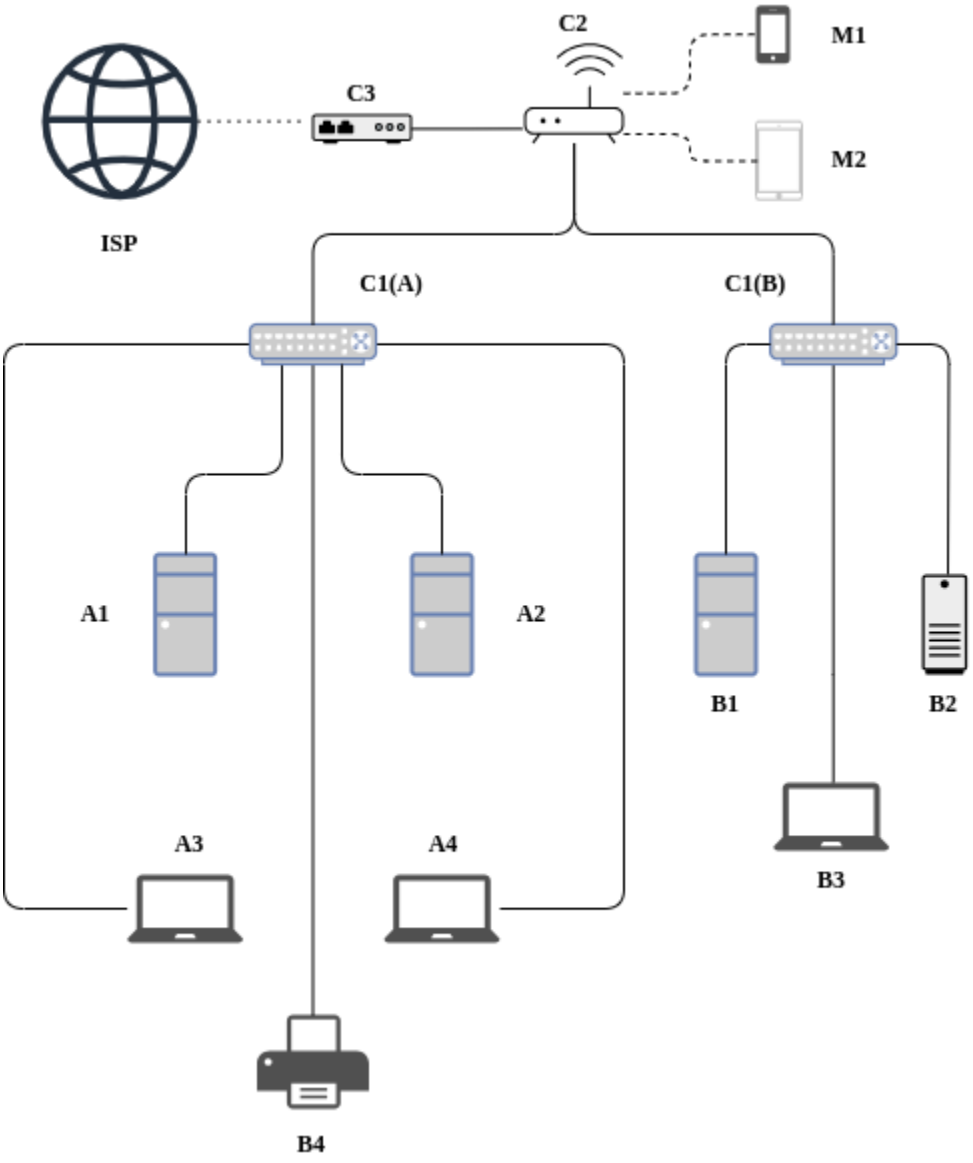
Network Diagram



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Legend			
Code	**Device Name**	**Device Type**	**Network Role**
A1	Dell OptiPlex 7010 Micro	Windows Low-End Desktop	Primary Network (A)
A2	Alienware Aurora R16	Windows High-End Desktop	Primary Network (A)
A3	Dell Inspiron 14	Windows Low-End Laptop	Primary Network (A)
A4	Dell XPS 13	Windows High-End Laptop	Primary Network (A)
B1	Precision 5860 Tower Workstation	Linux Desktop	Secondary Network (B)
B2	Mac Studio (M3 Ultra)	macOS Desktop	Secondary Network (B)
B3	MacBook Pro 16” (M4 Max)	macOS Laptop	Secondary Network (B)
B4	Brother MFC-L8900CDW	Printer	Primary Network (A)
M1	iPhone 16 Pro (1TB)	Smartphone	Secondary Network (B, Wi-Fi)
M2	iPad Pro 13” (1TB, M4 Chip)	Tablet	Secondary Network (B, Wi-Fi)
C1	NETGEAR 8-Port PoE+ Switch (x2)	Switch	Network Backbone
C2	Orbi Pro WiFi 6 Mini AX1800	Router/Wireless AP	Wireless Routing/AP
C3	SURFboard S33 DOCSIS 3.1 Cable Modem	Modem	ISP Gateway
Solid Line	Cat 6a Ethernet Cable		
Dotted Line	Coaxial Cable Line		
Dashed Line	802.11 a WiFI		

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Summary Spreadsheet

Category	Total Quantity	Subtotal
Desktops	4	$13,652.34
Laptops	3	$6,158.98
Networking Equipment	4	$758.97
Mobile & Peripherals	3	$4,047.99
Grand Total	14	$24,618.28

Device Name	Diagram Code	Unit Price	Quantity	Total
Dell OptiPlex 7010 Micro	A1	959	1	959
Alienware Aurora R16	A2	3,349.99	1	3,349.99
Precision 5860 Tower Workstation	B1	5,344.35	1	5,344.35
Mac Studio (M3 Ultra)	B2	3,999	1	$3,999

Device Name	Diagram Code	Unit Price	Quantity	Total
Dell Inspiron 14	A3	699.99	1	699.99
Dell XPS 13	A4	1459.99	1	1459.99
MacBook Pro 16” (M4 Max)	B3	3999	1	3999

Device Name	Diagram Code	Unit Price	Quantity	Total
NETGEAR 8-Port PoE+ Switch (x2)	C1	129.99	2	259.98
Orbi Pro WiFi 6 Mini (SXK30)	C2	299.99	1	299.99
SURFboard S33 DOCSIS 3.1 Cable Modem	C3	199	1	199

Device Name	Diagram Code	Unit Price	Quantity	Total
iPhone 16 Pro 1TB Black	M1	1499	1	1499
iPad Pro 13”	M2	1899	1	1899
Brother Color MFC-L8900CDW	B4	649.99	1	649.99

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Configuration

The network is established on a fast and secure basis, beginning with the SURFboard S33 DOCSIS 3.1 Cable Modem (C3). The modem is then connected to the ISP and provides up to 3.5 Gbps throughput. The modem is then connected to the Orbi Pro WiFi 6 Mini AX1800 Router (C2) using a Cat6a Ethernet cable, which then provides internet access to the network. The router is configured with DHCP to provide dynamic IP addresses to most of the devices and reserve specific static addresses to key endpoints.

Parameter	Value
SSID	Hidden
Encryption	WPA3
MAC Address Filtering	Enabled
DHCP Range	192.168.10.10 – 192.168.10.200
Reserved Static IP - Linux Workstation (B1)	192.168.10.201
Reserved Static IP - Printer (B4)	192.168.10.100
Firmware Version	V1.0.9.90
Firewall Default	Block all inbound traffic
Firewall Allowed	SSH (TCP 22), HTTPS (TCP 443), Dev Server (TCP 3000)
ICMP (ping) from WAN	Blocked

Network Address Translation (NAT)
Enabled by default on the Orbi Pro WiFi 6 Mini router. Conducts dynamic NAT to enable internal private IP addresses (192.168.10.0/24) to access external public networks through the ISP. NAT allows hiding of internal IPs and is a fundamental part of outbound traffic direction and security.

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External Port	Forwarded To
TCP 22	Linux Workstation (SSH)
TCP 3000	Dev Server Instance
TCP 443	Mac Studio Web Server

Parameter	Value
Model	NETGEAR 8-Port PoE+ Unmanaged Switch
Ports	Auto-negotiated 1Gbps
PoE Power Budget	83W each
Energy Efficiency	Enabled

Diagram Code	Device	OS/Firmware	IP Assignment	Applications/Functions
A1	Dell OptiPlex 7010 Micro	Windows 11 Pro (64-bit)	DHCP	MS Office, Edge, GitHub Desktop
A2	Alienware Aurora R16	Windows 11 Pro (64-bit)	DHCP	Visual Studio, Unity, Docker, Postman
A3	Dell Inspiron 14	Windows 11 Home (64-bit)	DHCP	Email, Slack, VSCode
A4	Dell XPS 13	Windows 11 Pro (64-bit)	DHCP	PyCharm, Git, VirtualBox
B1	Precision 5860 Tower Workstation	Ubuntu 22.04 LTS (64-bit)	Static (192.168.10.201)	Docker, SSH, Node.js, VSCode Server
B2	Mac Studio (M3 Ultra)	macOS Sonoma (ARM64)	DHCP	Xcode, Swift, Figma, Slack
B3	MacBook Pro 16” (M4 Max)	macOS Sonoma (ARM64)	DHCP	Xcode, GitHub CLI, Zoom
M1	iPhone 16 Pro	iOS 18	DHCP via Wi-Fi	Safari, Mail, TestFlight
M2	iPad Pro 13”	iPadOS 18	DHCP via Wi-Fi	Notability, Procreate, Safari
B4	Brother MFC-L8900CDW	Firmware vL8.00	Static (192.168.10.100)	Printing, Scanning, Network Backup

Feature
Unique login passwords for each device
Local firewall enabled (Windows Defender, UFW, macOS firewall)
SSH key authentication for Linux (B1)
Remote wipe enabled on M1 and M2
All unused ports closed via router/firewall

Connectivity
Cat6a Ethernet for all wired connections
802.11ax WiFi 6 with dual-band for wireless (M1, M2)
DHCP and DNS services managed via router

Backup Strategy
Daily backups to Google Drive, iCloud, OneDrive
Development files version-controlled (GitHub/GitLab)
macOS/Linux backups with Time Machine or rsync

Justification

To support my career in software development and computer science, I selected each piece of equipment within my network selective based on performance, flexibility, compatibility,

and requirements for development. The network was divided into two; a Primary Network (A) for Windows productivity and general development purposes, and a Secondary Network (B) for macOS, Linux, mobile, and testing environments.

Primary Network (A):

To be within a reasonable budget for everyday computing, I chose the Dell OptiPlex 7010 Micro (A1) as a budget Windows desktop. Primarily used for documentation, admin, and a bit of development with cloud-based IDEs or GitHub Copilot. For the heavier workloads, I added the Alienware Aurora R16 (A2), a high-end Windows desktop with the newest graphics and processing features, ideal for running intensive workloads locally like Visual Studio, or training AI models. Mobility is needed in the hybrid work environment of today. Which lead me to the Dell Inspiron 14 (A3) as my affordable lightweight laptop for taking notes, editing code on the go, and working remotely. For the high end I choose the Dell XPS 13 (A4), my high-end Windows laptop of choice for full-stack development, Docker, and virtual environment on the road. A Brother MFC-L8900CDW (B4) printer with multifunction features is supplied to perform high-duty printing and scanning of reports, contracts, and project documentation. It is network-enabled, so it can be accessed by everyone in the SOHO setup.

Secondary Network (B):

Cross-platform compatibility is the first consideration in my software development. To simulate Linux-based servers and cloud-native infrastructure, I opted for the Precision 5860 Tower Workstation (B1) with Ubuntu LTS. The computer will serve as host for containerized workflow, backend testing, and remote server emulations using Docker and Visual Code Server.

Apple development is also critical for both iOS/macOS compatibility testing and native Swift development. Choosing macOS desktop for Xcode intensive builds, design, and mobile app emulation is the Mac Studio (B2). For mobility the MacBook Pro 16"" (B3) is a high-end portable macOS workstation, which is ideal for cross-platform dev, Swift UI prototyping, hackathons or client meetings.

For mobile access, the iPhone 16 Pro (M1) and iPad Pro 13" (M2) will allow me to test responsive designs, natively test mobile applications, and address remote work for a project. The iPad also doubles as a whiteboard or planning session tool for project sprints as it uses the Apple Pencil and has an M4 chip powering it.

Network Backbone:

For connectivity and security, the fast ISP connectivity is provided by the SURFboard S33 DOCSIS 3.1 Modem (C3). A reliable wireless performance with WPA3 encryption is provided by the Orbi Pro WiFi 6 Mini (C2) router/AP. Two NETGEAR 8-Port PoE+ Switches (C1) offering enough wired ports, with future expansion ability, and power over Ethernet for neat cabling.

All the gear is linked using Cat6a cabling for secure gigabit speeds, and DHCP is switched on for IP address management on the fly. Security is also turned on with MAC filtering, port shutdowns, device-specific firewalls, and individual passwords per device. All these combined enable my full-stack development process, mobile test procedures, and collaboration tools with performance and security considerations.