**Managing My Network by Lana Bracken**

**1. What Did You Do?**

I selected my home network as the case study for this assignment to gain a hands-on understanding of network design and documentation. My approach involves a comprehensive strategy: first, I define key network terms (reach, range, responsiveness) to establish a foundational understanding, and then, I focus on developing user personas based on past user behavior and expectations.

My initial steps involved:

1. **Device Inventory and Connection Mapping:** I documented all internet-connected devices, recording their device type, connection method (wired, wireless, Bluetooth), and, for wireless devices, the Wi-Fi frequency used (2.4 GHz or 5 GHz).
2. **Device Power Source:** I documented the power source for each device, noting whether it was plugged into a standard wall outlet, power strip, or surge protector.
3. **Network Topology Visualization:** I created a visual representation of the network’s physical layout, including device locations, router and booster placement, and potential signal obstructions.
4. **Performance Observation:** I compared wireless and wired file download speeds on my work laptop to demonstrate performance differences and possible effects.
5. **ISP and Equipment Specifications Review:** I examined the technical specifications of my existing router, Wi-Fi booster, and ISP service package, including speed tiers, data limits, and the Service Level Agreement (SLA).

To understand network demands, I documented user needs information based on recollection of typical usage patterns, expectations, and perceived limitations for all household members. While this approach was practical for my home network, I acknowledge that best practices for a small business would involve data collection via interviews and questionnaires.

**2. What Are the Results?**

**2.1 Network Overview**

To gain a detailed understanding of my network's physical layout, I created the diagram below.

A screenshot of a computer

AI-generated content may be incorrect.

Figure 1: Network Overview

This diagram illustrates the location of all internet-connected devices, their connection types (Wi-Fi frequency: 2.4 GHz or 5 GHz), and areas of potential signal strength concern. For reference, the home office dimensions are 11 ft x 13 ft, and the approximate distance between the Router (1) and the Wi-Fi Extender (10) is 40 ft. The second story is a true second story, roughly mirroring the main floor's dimensions. It is important to note that the ISP's pad-mounted transformer, not pictured, is located within my property boundary, precisely 50 ft north of the router, which mitigates the risk of service disruption due to external construction or digging activities in the neighborhood.

The diagram, coupled with iPhone speed test results, reveals a critical signal degradation issue in the basement (highlighted in red). The Apple TV's location, almost directly below the Thermostat (8) and approximately 15 ft from the router, should provide adequate signal strength. However, the presence of concrete walls is the primary cause of a significant signal drop. According to CenturyLink (2025), this is consistent with the general behavior of Wi-Fi signals and estimated range:

* **2.4 GHz signals** offer greater range and better penetration through obstacles like walls due to their longer wavelength. They are typically suitable for covering larger areas and connecting devices that are farther from the Router or separated by walls.
  + Indoors: Typically, around 150 feet (45 meters).
  + Outdoors: Can reach up to 300 feet (90 meters) or more in ideal conditions.
* **5 GHz signals,** while providing higher bandwidth and faster speeds, have a shorter range and are more susceptible to attenuation by physical barriers.
  + Indoors: Usually around 50 to 100 feet (15 to 30 meters).
  + Outdoors: Might reach up to 200 feet (60 meters) in open areas, but this is highly variable.

In this case, the basement's concrete walls are likely absorbing the 5 GHz signal, leading to the observed weakness. This is confirmed by an iPhone speed test, which shows an 87.3% decrease (~403.3 Mbps) in download speed and a 64.1% decrease in upload speed in the basement, compared to the home office. This signal degradation, combined with the increased jitter (6 ms in the basement vs. 2 ms in the home office), renders the Apple TV nearly unusable for live streaming, as evidenced by a frustrating US Open viewing experience last year. In a small business context, this level of signal degradation would be unacceptable, impacting real-time communication, data transfer, and potentially customer-facing presentations.

**2.2 Network Requirements Analysis**

My home network supports diverse needs, including remote work, online education, entertainment, and home automation. To ensure these needs are met effectively, the following network requirements are crucial:

* **Availability:** A highly reliable internet connection is paramount, particularly for my remote work, requiring consistent connectivity for my laptop. Any network downtime directly impacts my productivity and the functionality of smart home devices. Fortunately, my smart home devices are not mission critical. For entertainment, while less critical, the ability to consistently stream content on smart TVs is a significant user expectation. In a business context, high availability is essential for business continuity and avoiding revenue loss.
* **Capacity:** The network must have sufficient capacity to support multiple devices simultaneously performing bandwidth-intensive tasks, such as video conferencing, large file transfers, and high-definition streaming. Insufficient capacity leads to slowdowns, buffering, and a degraded user experience. In a small business, this results in reduced employee productivity and potential communication breakdowns.
* **Coverage:** While the Wi-Fi booster extends the signal, the basement dead zone presents a significant coverage problem. In a small business, this would equate to areas where employees or customers cannot access the network, hindering productivity or service delivery.

**2.3 User Needs Assessment**

A user needs assessment, based on recollection of typical usage patterns, was conducted to understand the specific demands placed on the network. The user priority is as follows: work, school, automation, and entertainment. The primary users and their needs are:

* **Work Laptop (Myself):** As a software engineer for a company that develops feedyard software, I require a stable, low-latency connection for optimal productivity during work hours (8 AM - 5 PM) and online school hours (5 PM - 11 PM). Specifically:
  + To ensure optimal productivity with the work laptop, especially during video conferencing, consistent latency is essential. Latency, as defined by Zoom support, is the delay between a packet being sent and received. Zoom's documentation states that a latency of 150 ms or less is generally recommended for real-time communication. Higher latency introduces noticeable delays between audio and video, causing disruptions such as participants speaking over each other. For instance, a high latency can result in a significant delay between a user speaking and the other participant hearing their words. The measured latency of 63 ms in my network is well within the recommended threshold, and therefore does not represent an immediate problem. However, from a business perspective, maintaining low and stable latency is crucial for professional communication, so ongoing monitoring and optimization would be considered.
  + High bandwidth is essential for downloading large feedyard datasets (potentially several gigabytes) for customer support. Delays in these downloads directly impact my ability to diagnose and resolve customer issues promptly, which is critical for maintaining customer satisfaction.
  + I initially maintained a secondary ISP to provide network redundancy, primarily to support online school activities that involved timed exams. This service has since been discontinued. The primary reason for this change is that timed exams have not been part of my curriculum for the current and past semesters. Additionally, I have found that cellular hotspot connectivity is sufficient for handling occasional, short-term internet outages. However, the current reliance on cellular hotspot connectivity as the primary failover mechanism is not a robust long-term strategy, especially for a small business. Cellular hotspots are subject to fluctuations in signal strength and bandwidth availability, particularly during peak usage times in the area. This can lead to inconsistent connection speeds and increased latency, which are unacceptable for demanding applications like video conferencing, large file transfers, and accessing cloud-based business applications. Furthermore, sustained hotspot usage can strain cellular data limits, potentially incurring overage charges or throttling, further hindering productivity.
* **Streaming Devices (Apple TV, Roku, Smart TV):** These devices require high-speed, high-bandwidth internet for smooth, uninterrupted streaming, primarily during evenings and weekends. The basement's signal degradation directly impacts the Apple TV's usability, causing frustration and limiting entertainment options.
* **IoT Devices (Vacuum, Thermostats, Google Home Minis):** These devices require consistent connectivity for automated functions and remote control. The reliance of the Google Home Minis on a continuous internet connection represents a single point of failure. A network outage renders them completely useless. While the thermostats and vacuum can operate, the vacuum is unable to relay error messages. In a business context, this level of dependence on cloud services would necessitate a backup plan.
* **iPhones:** These devices utilize the Wi-Fi network to minimize cellular data usage, a common practice in both home and business settings.

**2.4 Equipment Analysis**

The current network infrastructure consists of:

* **Router:** A Gateway 6 - Wi-Fi 6 (802.11ax) Gateway (provided by the ISP) with WPA2 security (and options for WPA/WPA2). The router is connected via a fiber optic cable. The router currently supports 11 Wi-Fi connections, and has a maximum capacity of 23. While the router has sufficient capacity for the current setup, in a small business setting it's crucial to proactively assess its long-term suitability. Factors such as the type of devices, their bandwidth demands, and the potential for increased network traffic should be considered.
* **Wi-Fi Booster:** Used to extend the wireless signal to certain areas, primarily the garage, patio, and driveway.
* **Power:** A thorough review of the power infrastructure reveals different levels of concern for a home network versus a small business network.
  + My work setup, consisting of the docking station and two monitors, is connected to a Tripp Lite surge protector/power strip supplied by my employer (installed in June 2021), and the presence of a "Protected" light confirms its surge protection capabilities.
  + Standard wall outlets power the router, printer, Google Home Minis, robotic vacuum, Wi-Fi booster, and smart television.
  + In the basement, the Apple TV and other home theater components are powered by a Watt Box power strip/surge protector that is over 10 years old . The Watt Box also has a green "Protected" light, indicating it is a surge protector. The projector and speakers in the basement are connected to standard wall outlets.
  + The following points highlight the power-related issues:
    - UPS Protection: In a small business environment, implementing UPS (Uninterruptible Power Supply) protection for the router and work setup is essential to safeguard against power fluctuations and outages, preventing data loss and ensuring business continuity. This is less critical for a home network, where brief interruptions may be tolerable.
    - Safety Hazard: The aged Watt Box power strip/surge protector in the basement poses a safety hazard (fire risk) and should be replaced immediately, regardless of whether it's a home or business network.
    - Surge Protection: While surge protectors are used in the home office, it would be wise to extend surge protection to other devices, particularly the projector and speakers, to safeguard them from power surges in any setting.

**2.5 Service Provider & SLA Analysis**

The current ISP is Optimum, with the following service tier:

* **Service Tier:** 500 Mbps Internet
* **Download Speeds:** Up to 500 Mbps
* **Upload Speeds:** Up to 20 Mbps
* **Data Usage (Last 3 Months):** 681 GB downloaded, 129 GB uploaded
* **Data Usage (Last Month):** 166 GB downloaded, 26 GB uploaded

The residential SLA provided by Optimum lacks guaranteed uptime and customer support response times. While I have been satisfied with their performance for decades, a business-oriented solution would necessitate a more robust SLA, including specific performance metrics and compensation for outages. The download speed has been sufficient.

**2.6 Wired vs. Wireless Performance Comparison**

To quantify the performance difference between wired and wireless connections for work-related activities, I conducted a comparison test on my work laptop.

Table 1: Comparison of Wireless vs Wired Speeds on Work Laptop

|  |  |  |  |
| --- | --- | --- | --- |
| **Metric** | **Wireless Speed Test** | **Wired Speed Test (Cat 5e)** | **Comparison** |
| Download Speed | 506.0 Mbps | 529.6 Mbps | Wired is ~23.6 Mbps faster (~4.6% increase). |
| Upload Speed | 21.5 Mbps | 21.6 Mbps | Nearly identical upload speeds. |
| Ping (Latency) | 63 ms | 63 ms | Identical latency. |
| Jitter | 4 ms | 1 ms | Wired has lower jitter, thus more stable connectivity. |

The results clearly demonstrate that wired connections offer benefits in terms of download speeds and stability. While the download speed increased only marginally (~4.6% or 23.6 Mbps), the lower jitter on the wired connection is more significant for real-time applications.

**3. What Did You Learn? (Key Takeaways)**

Socrates once said, *“You can only know what you know. You can’t know what you don’t know.”* This assignment has been both enlightening and humbling. I have gained new insights, such as the fact that not all cables are the same - especially Ethernet cables. There are various types, including Cat 5e, Cat 6, Cat 6a, Cat 7, Cat 8, and even the now-outdated Cat 5.

This assignment has significantly broadened my understanding of digital networks. I used to see my home internet setup simply as a way to connect devices. I now recognize that it's a complex network infrastructure that must be carefully designed and managed to effectively support a diverse range of applications, including remote work, online education, entertainment, and home automation. This shift in perspective is a key takeaway.

One practical lesson involves Wi-Fi security. While my Router offers the flexibility to switch from WPA2 to WPA/WPA2 to accommodate older devices, I now understand that this presents a security trade-off. WPA is inherently less secure than WPA2, and enabling it increases the network's vulnerability to unauthorized access. This highlights the critical importance of balancing backward compatibility with robust security measures, a common challenge in network design.

The most impactful learning experience was resolving the connectivity issue with my older Roku device. This device, having been configured for a previous network, could not connect to the current one. The solution involved a deeper understanding of network identifiers (SSIDs) and authentication. By temporarily reconfiguring my iPhone's hotspot to mimic the previous network's SSID and password, I effectively "tricked" the Roku into connecting. This allowed me to access its settings and update them for the current network. This exercise demonstrated the importance of understanding network configuration parameters and the creative problem-solving required in network management.

Several actionable takeaways emerged for improving my home network, with clear implications for small business network design:

* **ISP SLA Scrutiny:** Thoroughly review ISP Service Level Agreements (SLAs) to understand uptime guarantees, support response times, and potential penalties for service disruptions. This is crucial for business continuity planning, as residential SLAs often lack the guarantees required for business operations.
* **Wired Infrastructure Prioritization:** Prioritize wired Ethernet connections for critical devices like workstations to minimize latency and jitter, ensuring stable performance for real-time applications such as video conferencing. This is particularly important in a business environment where reliable communication and data transfer are essential.
* **Power Protection and Reliability:** This assignment made it eye-openingly clear that I need to update my surge protectors and consider adding additional ones. Given the frequent wind storms in West Texas and the associated power outages and fluctuations caused by Xcel Energy, reliable power protection is essential for all electronic devices, not just computers. Implementing UPS systems for critical network equipment (router, modem, etc.) would provide an additional layer of protection against brief outages and voltage sags, which can be just as damaging as full outages. In a small business setting, this is non-negotiable. For a simple home network, UPS would be overkill.

I also gained a brief understanding of Wi-Fi analyzer applications (such as Acrylic Wi-Fi Home) and their importance in network optimization. These tools offer valuable capabilities, including signal strength measurement for precise access point placement and identification of weak signal areas, and heatmap generation to visually represent signal strength across a floor plan, greatly assisting in network design and troubleshooting efforts. In a small business setting, these tools would be indispensable for designing efficient and reliable wireless networks, optimizing access point placement, and proactively addressing connectivity issues.

I look forward to expanding on the knowledge gained from this exercise and applying it to the final assignment. I'm excited for the opportunity to put these skills to the test in a real-world small business security audit.