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<tr><td colspan="2">Course and Course Code:
DATA COMMUNICATION CONCEPTS / NWC2063</td><td>Submission Date:</td></tr>
<tr><td colspan="2">Assignment No. / Title:
PROJECT</td><td>Extension & Late submission: Disallowed</td></tr>
<tr><td>Assignment Type:
GROUP</td><td>% of Assignment Mark
20%</td><td>Returning Date:</td></tr>
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1. 10% of the original mark will be deducted for every one week period after the submission date.
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Signature(s):

MUHAMMAD SYAZNIZAM BIN JAMAL

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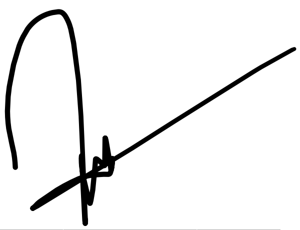

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This section may be used for feedback or other information

1.0 Introduction

1.1 General Introduction:

In the era of digitalization, where connectivity is essential for both individuals and enterprises, network performance is a crucial factor in determining success. It includes the effectiveness, dependability, and velocity with which data moves over a network architecture. As technology advances and the need for digital communication grows, network performance optimisation becomes a critical goal for businesses looking to boost output, client happiness, and competitive advantage. Network performance is a critical component of modern operations, impacting everything from speedy user experience to smooth data delivery, whether in wired or wireless situations.

1.2 Specific Introduction:

In the context of network performance, a number of crucial measures and variables are crucial in determining how successful digital connectivity is. Fundamental characteristics that directly affect the speed and dependability of data transmission across networks include bandwidth, latency, and throughput. In addition, problems like packet loss, jitter, and network congestion necessitate proactive management techniques to lessen their negative performance impacts. By closely observing, evaluating, and refining these components, companies can improve the effectiveness of their network infrastructure and open doors for development and innovation in a world where connectivity is becoming more and more important.

2.0 PROBLEM STATEMENT

1. The coexistence of multiple wireless devices, including smartphones, laptops, smart TVs, and IoT gadgets, along with household appliances such as microwaves and cordless phones, contributes to significant Wi-Fi interference in residential settings. Additionally, building materials like concrete walls and metal structures can obstruct signal propagation and exacerbate interference, resulting in unreliable internet connectivity, dropped connections, and reduced network speeds.

2. Peak usage hours in household networks often strain available bandwidth resources, resulting in network congestion, increased latency, and degraded performance for users engaging in activities such as streaming video content, online gaming, and video conferencing. Furthermore, the proliferation of connected devices and simultaneous data-intensive tasks further exacerbate congestion issues, causing frustation and inconvenience for household members.

3. Construction activities near residential areas can disrupt home internet connectivity due to environmental interference such as vibrations, electromagnetic interference, and physical damage to underground cables or above-ground infrastructure. These disruptions can lead to service outages, degraded performance, and increased downtime for internet users, affecting productivity and daily activities reliant on a stable internet connection.

3.0 OBJECTIVE

1. Strategically placing router in a central location away from obstructions like concrete walls and metal structures. Upgrade to dual-band or tri-band routers to access less crowded frequencies, and regularly check and adjust your router's channel settings to minimize interference. Consider using mesh Wi-Fi systems for broader coverage and stability. Additionally, keep household appliances like microwaves and cordless phones away from your router, and prioritize wired connections for devices that require high bandwidth.

2. Tackle peak hour network congestion in household environments is to schedule bandwidth-intensive activities during off-peak hours. By encouraging household members to perform tasks like software updates, large file downloads, or cloud backups during times when network usage is generally lower, such as late at night or early in the morning, alleviate strain on the network during peak hours.

3. Wait until the construction is completed. Once the construction activities cease, the likelihood of interference with internet infrastructure diminishes, allowing for stable and uninterrupted connectivity. During this period, temporary solutions like utilizing mobile data or seeking alternative internet options can help bridge the gap until normal service resumes.

4.0 METHODS

4.1 Internet connection used:

Broadband - TIME Internet (500mbps Plan - RM145.22) connected via router wireless connection

4.2 Hardware and the software (Operating System) used:

Type	PC
Device Model	MSI GF63 Thin 10SCXR
Operating System	Windows 11
Internet Access	Router Wireless Connection

4.3 Tools used to measure response time:

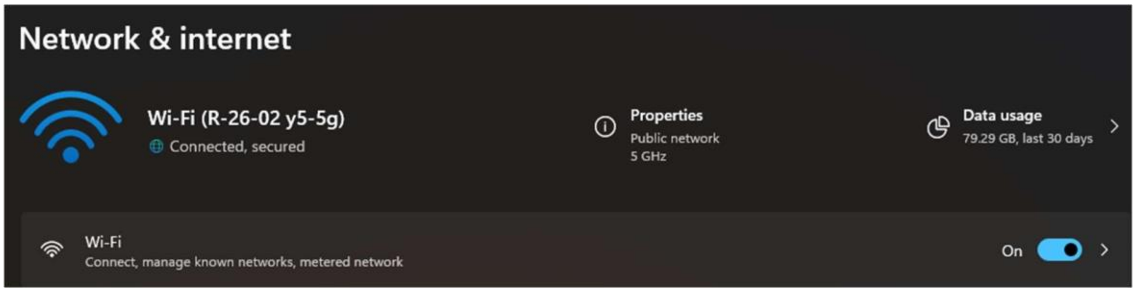
```
C:\Users\USER>ping

Usage: ping [-t] [-a] [-n count] [-l size] [-f] [-i TTL] [-v TOS]
            [-r count] [-s count] [[-j host-list] | [-k host-list]]
            [-w timeout] [-R] [-S srcaddr] [-c compartment] [-p]
            [-4] [-6] target_name
```

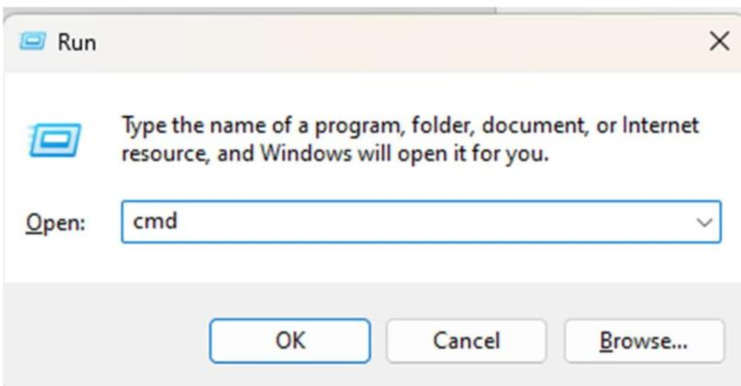
ping is a command available in the Microsoft Windows command prompt, designed to assess internet connectivity and determine average response times swiftly. This feature comes pre-installed with Microsoft Windows. Utilizing the “ping” command is straightforward: users simply open the command prompt and enter “ping” to access a comprehensive list of parameters. From there, they can customize their ping tests to suit their specific needs, including specifying target hosts, adjusting packet sizes, and configuring timeout settings. Within this project, we leverage the versatility of the “ping” command to conduct systematic tests of internet connectivity and response times. By sending data packets to a designated host at various intervals throughout the day, we are able to collect valuable data on network performance over time. This data allows us to analyze trends, identify potential issues, and optimize network configurations for optimal performance. Additionally, by calculating average response times for each testing session, we gain insights into the reliability and consistency of our internet connection under different conditions.

4.4 Steps taken for experiment:

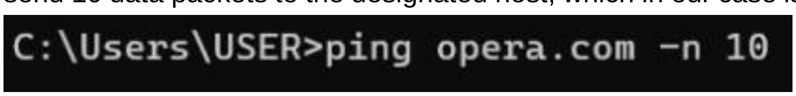
a) Connect the device to WiFi



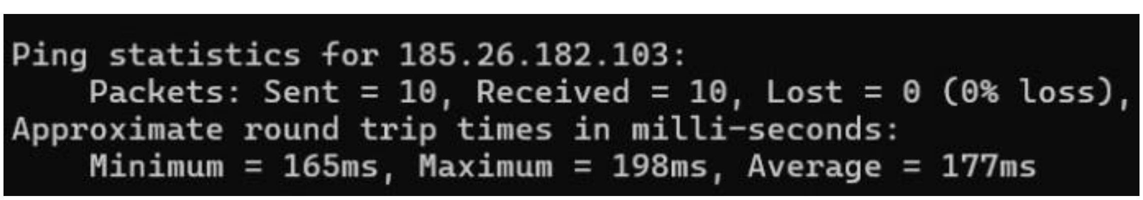
b) To initiate the Windows Command Prompt, employ a keyboard shortcut by simultaneously pressing the Windows key and the letter “R” to access the Run dialog. Then, input “cmd” into the provided text box and press Enter.



c) Execute the command “ping opera.com -n 10” to initiate the process. This command will send 10 data packets to the designated host, which in our case is the Opera server.



d) Kindly await the conclusion of the test. Upon completion, the approximate round trip time in miliseconds will be showcased. To ascertain the average response time, kindly refer to the bottom-right section of the display.



e) Repeatedly conduct the procedure at varying times over the next three days to accumulate a comprehensive dataset.

5.0 RESULTS

DAY 1

2pm

```
C:\Users\USER>ping opera.com -n 10

Pinging opera.com [185.26.182.103] with 32 bytes of data:
Reply from 185.26.182.103: bytes=32 time=166ms TTL=58
Reply from 185.26.182.103: bytes=32 time=165ms TTL=58
Reply from 185.26.182.103: bytes=32 time=166ms TTL=58
Reply from 185.26.182.103: bytes=32 time=166ms TTL=58
Reply from 185.26.182.103: bytes=32 time=180ms TTL=58
Reply from 185.26.182.103: bytes=32 time=197ms TTL=58
Reply from 185.26.182.103: bytes=32 time=166ms TTL=58
Reply from 185.26.182.103: bytes=32 time=178ms TTL=58
Reply from 185.26.182.103: bytes=32 time=196ms TTL=58
Reply from 185.26.182.103: bytes=32 time=198ms TTL=58

Ping statistics for 185.26.182.103:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 165ms, Maximum = 198ms, Average = 177ms
```

6pm

```
C:\Users\USER>ping opera.com -n 10

Pinging opera.com [185.26.182.103] with 32 bytes of data:
Reply from 185.26.182.103: bytes=32 time=175ms TTL=58
Reply from 185.26.182.103: bytes=32 time=182ms TTL=58
Reply from 185.26.182.103: bytes=32 time=165ms TTL=58
Reply from 185.26.182.103: bytes=32 time=176ms TTL=58
Reply from 185.26.182.103: bytes=32 time=177ms TTL=58
Reply from 185.26.182.103: bytes=32 time=177ms TTL=58
Reply from 185.26.182.103: bytes=32 time=191ms TTL=58
Reply from 185.26.182.103: bytes=32 time=165ms TTL=58
Reply from 185.26.182.103: bytes=32 time=171ms TTL=58
Reply from 185.26.182.103: bytes=32 time=169ms TTL=58

Ping statistics for 185.26.182.103:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 165ms, Maximum = 191ms, Average = 174ms
```

10pm

```
C:\Users\USER>ping opera.com -n 10

Pinging opera.com [185.26.182.104] with 32 bytes of data:
Reply from 185.26.182.104: bytes=32 time=246ms TTL=58
Reply from 185.26.182.104: bytes=32 time=239ms TTL=58
Reply from 185.26.182.104: bytes=32 time=254ms TTL=58
Reply from 185.26.182.104: bytes=32 time=221ms TTL=58
Reply from 185.26.182.104: bytes=32 time=236ms TTL=58
Reply from 185.26.182.104: bytes=32 time=216ms TTL=58
Reply from 185.26.182.104: bytes=32 time=216ms TTL=58
Reply from 185.26.182.104: bytes=32 time=239ms TTL=58
Reply from 185.26.182.104: bytes=32 time=259ms TTL=58
Reply from 185.26.182.104: bytes=32 time=245ms TTL=58

Ping statistics for 185.26.182.104:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 216ms, Maximum = 259ms, Average = 237ms
```

DAY 2

2pm

```
C:\Users\USER>ping opera.com -n 10

Pinging opera.com [185.26.182.103] with 32 bytes of data:
Reply from 185.26.182.103: bytes=32 time=184ms TTL=56
Reply from 185.26.182.103: bytes=32 time=192ms TTL=56
Reply from 185.26.182.103: bytes=32 time=200ms TTL=56
Reply from 185.26.182.103: bytes=32 time=215ms TTL=56
Reply from 185.26.182.103: bytes=32 time=226ms TTL=56
Reply from 185.26.182.103: bytes=32 time=241ms TTL=56
Reply from 185.26.182.103: bytes=32 time=184ms TTL=56
Reply from 185.26.182.103: bytes=32 time=197ms TTL=56
Reply from 185.26.182.103: bytes=32 time=199ms TTL=56
Reply from 185.26.182.103: bytes=32 time=195ms TTL=56

Ping statistics for 185.26.182.103:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 184ms, Maximum = 241ms, Average = 203ms
```

6pm

```
C:\Users\USER>ping opera.com -n 10

Pinging opera.com [185.26.182.104] with 32 bytes of data:
Reply from 185.26.182.104: bytes=32 time=237ms TTL=58
Reply from 185.26.182.104: bytes=32 time=166ms TTL=58
Reply from 185.26.182.104: bytes=32 time=166ms TTL=58
Reply from 185.26.182.104: bytes=32 time=180ms TTL=58
Reply from 185.26.182.104: bytes=32 time=194ms TTL=58
Reply from 185.26.182.104: bytes=32 time=206ms TTL=58
Reply from 185.26.182.104: bytes=32 time=221ms TTL=58
Reply from 185.26.182.104: bytes=32 time=236ms TTL=58
Reply from 185.26.182.104: bytes=32 time=243ms TTL=58
Reply from 185.26.182.104: bytes=32 time=166ms TTL=58

Ping statistics for 185.26.182.104:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 166ms, Maximum = 243ms, Average = 201ms
```

10pm

```
C:\Users\USER>ping opera.com -n 10

Pinging opera.com [185.26.182.104] with 32 bytes of data:
Reply from 185.26.182.104: bytes=32 time=192ms TTL=58
Reply from 185.26.182.104: bytes=32 time=222ms TTL=58
Reply from 185.26.182.104: bytes=32 time=233ms TTL=58
Reply from 185.26.182.104: bytes=32 time=226ms TTL=58
Reply from 185.26.182.104: bytes=32 time=228ms TTL=58
Reply from 185.26.182.104: bytes=32 time=229ms TTL=58
Reply from 185.26.182.104: bytes=32 time=251ms TTL=58
Reply from 185.26.182.104: bytes=32 time=241ms TTL=58
Reply from 185.26.182.104: bytes=32 time=252ms TTL=58
Reply from 185.26.182.104: bytes=32 time=261ms TTL=58

Ping statistics for 185.26.182.104:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 192ms, Maximum = 261ms, Average = 233ms
```

DAY 3

2pm

```
C:\Users\USER>ping opera.com -n 10

Pinging opera.com [185.26.182.103] with 32 bytes of data:
Reply from 185.26.182.103: bytes=32 time=302ms TTL=58
Reply from 185.26.182.103: bytes=32 time=213ms TTL=58
Reply from 185.26.182.103: bytes=32 time=213ms TTL=58
Reply from 185.26.182.103: bytes=32 time=331ms TTL=58
Reply from 185.26.182.103: bytes=32 time=167ms TTL=58
Reply from 185.26.182.103: bytes=32 time=173ms TTL=58
Reply from 185.26.182.103: bytes=32 time=246ms TTL=58
Reply from 185.26.182.103: bytes=32 time=165ms TTL=58
Reply from 185.26.182.103: bytes=32 time=166ms TTL=58
Reply from 185.26.182.103: bytes=32 time=173ms TTL=58

Ping statistics for 185.26.182.103:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 165ms, Maximum = 331ms, Average = 214ms
```

6pm

```
C:\Users\USER>ping opera.com -n 10

Pinging opera.com [185.26.182.103] with 32 bytes of data:
Reply from 185.26.182.103: bytes=32 time=179ms TTL=58
Reply from 185.26.182.103: bytes=32 time=187ms TTL=58
Reply from 185.26.182.103: bytes=32 time=168ms TTL=58
Reply from 185.26.182.103: bytes=32 time=182ms TTL=58
Reply from 185.26.182.103: bytes=32 time=245ms TTL=58
Reply from 185.26.182.103: bytes=32 time=165ms TTL=58
Reply from 185.26.182.103: bytes=32 time=187ms TTL=58
Reply from 185.26.182.103: bytes=32 time=170ms TTL=58
Reply from 185.26.182.103: bytes=32 time=176ms TTL=58
Reply from 185.26.182.103: bytes=32 time=190ms TTL=58

Ping statistics for 185.26.182.103:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 165ms, Maximum = 245ms, Average = 184ms
```

10pm

```
C:\Users\USER>ping opera.com -n 10

Pinging opera.com [185.26.182.104] with 32 bytes of data:
Reply from 185.26.182.104: bytes=32 time=215ms TTL=58
Reply from 185.26.182.104: bytes=32 time=224ms TTL=58
Reply from 185.26.182.104: bytes=32 time=197ms TTL=58
Reply from 185.26.182.104: bytes=32 time=218ms TTL=58
Reply from 185.26.182.104: bytes=32 time=224ms TTL=58
Reply from 185.26.182.104: bytes=32 time=255ms TTL=58
Reply from 185.26.182.104: bytes=32 time=262ms TTL=58
Reply from 185.26.182.104: bytes=32 time=208ms TTL=58
Reply from 185.26.182.104: bytes=32 time=207ms TTL=58
Reply from 185.26.182.104: bytes=32 time=213ms TTL=58

Ping statistics for 185.26.182.104:
    Packets: Sent = 10, Received = 10, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 197ms, Maximum = 262ms, Average = 222ms
```

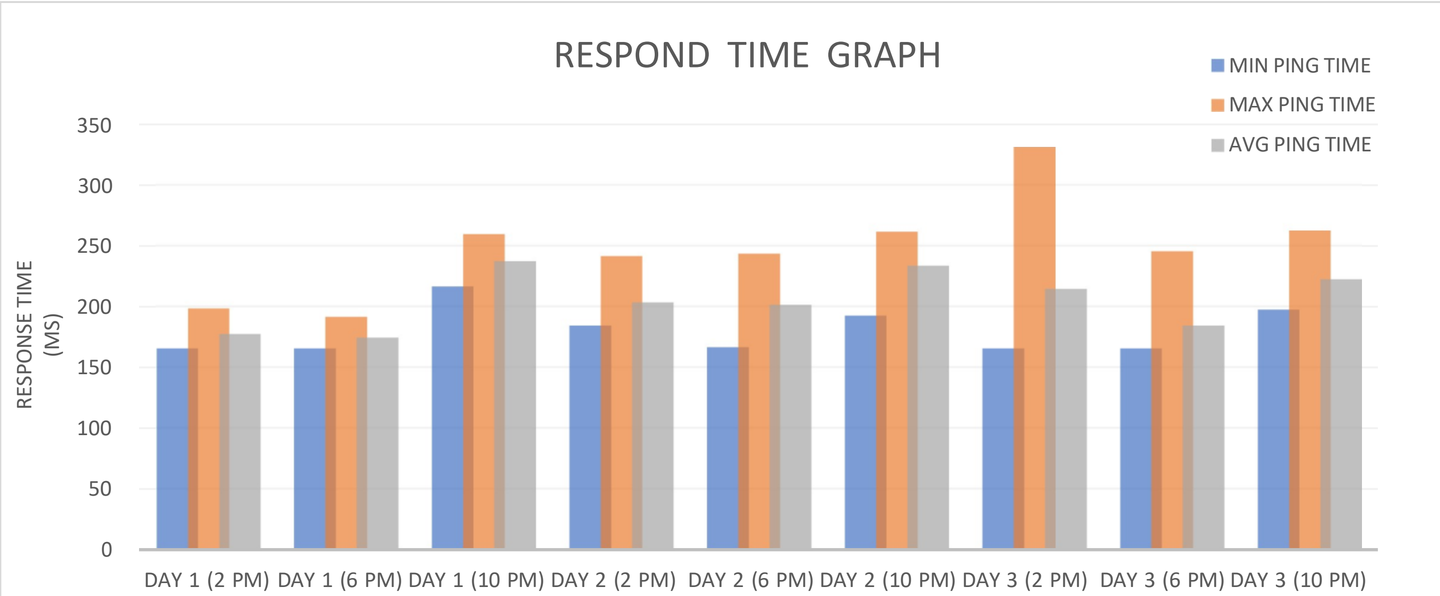
DATA TABLE

Example: NETWORK PERFORMANCE BASED ON TIME OF DAY AND TIME

DAY AND TIME

DAY & TIME	DAY 1 2 PM	DAY 1 6 PM	DAY 1 10 PM	DAY 2 2 PM	DAY 2 6 PM	DAY 2 10 PM	DAY 3 2 PM	DAY 3 6 PM	DAY 10 PM
MIN PING (ms)	165	165	216	184	166	192	165	165	197
MAX PING (ms)	198	191	259	241	243	261	331	245	262
AVG PING (ms)	177	174	237	203	201	233	214	184	222

6.0 ANALYSIS



The graph above depicts the response time variation between different times on
The same day over a three day period. The x axis represents the different days and time of the day, while the y axis ilustrates the minimum response time, max response time and average response time In milisecond (ms)

Observation:

1. Different times of days has shown noticebale varitations in response time for each time and day interval. Day 1 has sown a significant spike at 10 pm while at the beginning of day and at 2 pm and 6 pm has shown to be the most low recorded interval.
2. Peak response time: The highest maximum ping time are recorded on day 3 at 2 pm reaching 331 ms. This indicates that a potential peak in trend could be higher than that.
3. Lowest response time: The lowest maximum ping response time has been recorded on day 1 at 6 pm reaching only 191 ms. This indicates that maximum ping response time is manipulated due to the day and time of day

Conclusion:

In conclusion, the analysis records emphasise on considering both factors of time and day when assessing network performance. Understanding the patterns of response time Variations can aid in optimising network performance and in general improving user experience. To ensure consistency the analysis needs to be more thorough.

7.0 CONCLUSION

The analysis of network performance based on time and day reveals significant variations in response time across different intervals. Observations indicate notable spikes and dips in response time, with the most substantial increase recorded at 10 pm on Day 1. Conversely, the beginning of each day and the 2 pm to 6 pm intervals exhibit comparatively lower response times.

Peak response times, such as the maximum ping time of 331 ms on Day 3 at 2 pm, suggest potential trends indicating higher levels of latency. Conversely, the lowest maximum ping response time of 191 ms, recorded on Day 1 at 6 pm, underscores how response times are influenced by both the day and time of day.

In conclusion, this analysis underscores the importance of considering both temporal factors, such as time of day, and broader patterns when evaluating network performance. Understanding these variations can inform strategies to optimize network efficiency and enhance user experience. However, to ensure consistency and accuracy, further in-depth analysis and monitoring are recommended.

8.0 REFERENCE

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