Mehran University of Engineering and Technology, Khairpur
Department of Software Engineering

Course: SWE-Computer Network Practical			
Instructor	Dr. Asad Raza Malik	Practical/Lab No.	03
Date	07-08-2024	CLOs	03
Student's Roll no:		Point Scored:	
Date of Conduct:		Teacher's Signature:	

LAB PERFORMANCE INDICATOR	Subject Knowledge	Data Analysis and Interpretation	Ability to Conduct Experiment	Presentation	Calculation and Coding	Observation/ Result	Score

Topic	To become familiar with the use of Ping, Traceroute and tracert.
Objective	• To familiarize students with the use of network diagnostic tools such as `'ping'`, `'traceroute'`, and `'tracert'` for diagnosing and troubleshooting network issues.
Materials Required:	• Computers or Virtual Machines: At least one per student or group, with internet access • Operating Systems: Windows, Linux, or macOS • Network Connections: Wired or wireless network setup. • Network Interface Cards (NICs): These are used to connect to the network. • Cisco Packet Tracer Software: For simulation and testing of network scenarios • Network Diagnostic Tools: Built-in Commands like 'ping', 'traceroute' (Linux/macOS), and 'tracert' (Windows). • Ethernet Cables (optional): for physical network setup (if required).
Course Outcomes (Cos)	**CLO1: Mastery of Network Diagnostic Tools** • **Description:** Students will demonstrate proficiency in using ping, traceroute, and tracert to assess network connectivity and performance. • **Outcome:** Ability to effectively use these tools to verify the availability of network resources and diagnose issues. **CLO2: Analysis and Interpretation of Network Data** • **Description**: Students will analyze and interpret the results from network diagnostic tools to identify potential network problems. • **Outcome**: Ability to identify and understand common network issues such as high latency, packet loss, and routing loops. **CLO3: Application of Diagnostic Results** • **Description:** Students will apply the information obtained from diagnostic tools to suggest possible solutions to network problems.

	• **Outcome:** Ability to propose appropriate troubleshooting steps based on diagnostic data.
Program Outcomes (POs)	**PLO1: Engineering Knowledge** • **Description:** Apply knowledge of mathematics, science, and engineering principles to solve complex network engineering problems. • **Relevance to Lab**: Use fundamental networking principles to understand and operate diagnostic tools. **PLO2: Problem Analysis** • **Description:** Identify and analyze complex engineering problems, using first principles of engineering. • **Relevance to Lab**: Analyze network diagnostic data to identify and understand issues. **PLO3: Design/Development of Solutions** • **Description:** Design solutions for complex engineering problems, considering various constraints. • **Relevance to Lab:** Design effective troubleshooting strategies based on diagnostic tool outputs. **PLO5: Modern Tool Usage** • **Description:** Use modern engineering tools for complex engineering activities. • **Relevance to Lab:** Utilize network diagnostic tools like ping, traceroute, and tracert for practical applications.

Lab Discussion: Theoretical concepts and Procedural steps

1. Introduction to Network Diagnostics

Network Diagnostics tools are essential for monitoring, troubleshooting, and maintaining networks. These tools help identify network issues, measure performance, and understand the path that data takes through a network. The most used diagnostic tools include Ping, Traceroute, and Tracert.

2. What is the Ping command?

Ping is a command-line utility used to test the reachability of a host on an IP network. It measures the round-trip for messages sent from the source to a destination device and reports any packet loss. The tool is named after the sonar sound used to detect objects underwater.

2.1 Key Features of Ping:

- **Echo Request and Reply:** Ping sends an ICMP Echo Request to the target host, which responds with an Echo Request.
- **Round-Trip Time (RTT):** The time it takes for the request to travel to the target and back.
- **Packet Loss:** Ping report if packets are lost during transmission

2.3 Common Usage:

- Testing network connectivity.
- Determining the availability of a host.
- Measuring network latency.

Basic Command Syntax:

```
ping [hostname or IP address]
```

3. What is Traceroute and Tracert?

Traceroute (or Tracert in Windows) is a network diagnostic tool used to trace the path that data packets take from a source to a destination. It identifies each hop along the route and measures the time taken for each hop. This tool is invaluable for diagnosing routing issues and understanding the structure of a network.

3.1 Key Features of Traceroute/Tracert:

- **Hop-by-Hop Analysis:** Traces the route packets take and provides information about each intermediate device (hop).
- **Time-to-Live (TTL):** Determines the number of hops a packet can take before being discarded.
- **Response Time:** Measures the delay for each hop, helping identify slow or problematic links.

3.2 Common Usage:

- Mapping network paths.
- Diagnosing routing problems.
- Identifying bottlenecks in a network.

Basic Command Syntax:

- Linux/macOS:

```
traceroute [hostname or IP address]
```

- Windows:

```
tracert [hostname or IP address]
```

4. Practical Applications

1. **Connectivity Testing:** Ping is used to verify if a particular host is reachable and how long it takes to communicate with it. This is useful for troubleshooting network connectivity issues.

2. **Route Analysis:** Traceroute/Tracert helps network administrators understand the route data takes to reach its destination. It can identify where delays or failures occur in the path.
3. **Performance Monitoring:** Both tools can help measure the performance and reliability of a network by providing data on latency and packet loss.

5. Considerations and Limitations

- **Firewall and Security Settings:** Firewalls may block ICMP packets, preventing Ping and Traceroute from working as expected.
- **Variable Network Conditions:** The path and performance metrics obtained from Traceroute can change over time due to dynamic routing in networks.
- **Interpretation of Results:** The results from these tools require proper interpretation. For instance, occasional high latency on a single hop in Traceroute does not necessarily indicate a problem at that hop, as it could be due to routers' low priority handling of ICMP packets.

6. What is ipconfig?

ipconfig is a command-line utility available on Windows operating systems that provides detailed information about the network configuration of the computer. It can display the IP address, subnet mask, default gateway, and other important networking information. It is also used to refresh the DHCP and DNS settings.

6.1 Common ipconfig Commands:

1. **ipconfig**: Displays basic IP configuration information for all network adapters.
2. **ipconfig /all**: Displays detailed information about the IP configuration, including MAC address, DHCP status, and DNS server addresses.
3. **ipconfig /release**: Releases the current DHCP-assigned IP address for all adapters.
4. **ipconfig /renew**: Renews the DHCP-assigned IP address for all adapters.
5. **ipconfig /flushdns**: Clears the DNS resolver cache.
6. **ipconfig /displaydns**: Displays the contents of the DNS resolver cache.

7. What is nslookup?

nslookup (Name Server Lookup) is a command-line utility available on various operating systems, including Windows, macOS, and Linux, used to query the Domain Name System (DNS) to obtain domain name or IP address mapping information. It is commonly used for troubleshooting DNS issues and verifying DNS configurations.

7.1 Common nslookup Commands:

1. **nslookup**: Enters interactive mode where you can perform multiple DNS queries.
2. **nslookup [hostname]**: Queries the DNS to obtain the IP address associated with the specified hostname.

3. **nslookup [IP address]**: Queries the DNS to obtain the domain name associated with the specified IP address (reverse DNS lookup).
4. **nslookup [hostname] [DNS server]**: Queries a specific DNS server for information about the specified hostname.
5. **set type=[record type]**: Specifies the type of DNS record to look up (e.g., A, MX, TXT, etc.). This command is used in interactive mode.

Example Usage:

1. **Basic IP Address Lookup**

```
nslookup www.example.com
```

2. **Reverse DNS Lookup**:

```
nslookup 192.0.2.1
```

3. **Using a Specific DNS Server**:

```
nslookup www.example.com 8.8.8.8
```

4. **Interactive Mode**:

```
nslookup
> set type=MX
> example.com
```

These commands are invaluable tools for network administrators, and anyone involved in network troubleshooting and configuration, providing insights into how devices are configured and how they interact with DNS services.

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8. Lab Activity

Activity 1: Using Ping

1. **Objective:** Learn how to use Ping to check network connectivity and latency.
2. **Tasks:**
    - **Task 1:** Open a command prompt or terminal on your computer.
    - **Task 2:** Use the Ping command to test the connectivity to a local device (e.g., another PC in the lab). Example command:

```
ping [IP Address]
```

- **Task 3:** Ping a public server (e.g., Google's DNS server at 8.8.8.8) and record the results. Example command:

```
ping 8.8.8.8
```

```
Command Prompt
Microsoft Windows [Version 10.0.22631.3958]
(c) Microsoft Corporation. All rights reserved.

C:\Users\asadr>ping 8.8.8.8

Pinging 8.8.8.8 with 32 bytes of data:
Reply from 8.8.8.8: bytes=32 time=25ms TTL=54
Reply from 8.8.8.8: bytes=32 time=30ms TTL=54
Reply from 8.8.8.8: bytes=32 time=24ms TTL=54
Reply from 8.8.8.8: bytes=32 time=24ms TTL=54

Ping statistics for 8.8.8.8:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 24ms, Maximum = 30ms, Average = 25ms
```

- **Task 4:** Analyze the results:
  - Note the round-trip time (RTT) for each ping.
  - Discuss what high or low RTT values indicate about network performance.

Activity 2: Using Traceroute (Linux) or Tracert (Windows)

1. **Objective:** Understand the path packets take through the network and identify possible bottlenecks or failures.
2. **Tasks:**
   - **Task 1:** Open a command prompt or terminal on your computer.
   - **Task 2:** Use Traceroute (Linux) or Tracert (Windows) to trace the path to a public server (e.g., google.com). Example command for Windows:

```
tracert google.com
```

   - **Task 3:** Record the list of hops and their respective IP addresses.

```
C:\Users\asadr>tracert www.google.com

Tracing route to www.google.com [142.250.181.164]
over a maximum of 30 hops:

  1     8 ms    20 ms     7 ms  172.16.245.1
  2    11 ms    11 ms    11 ms  172.16.250.254
  3     9 ms     *        8 ms  172.16.251.1
  4    34 ms     *       54 ms  121.52.154.130.pern.pk [121.52.154.130]
  5     *        *        *     Request timed out.
  6     *        *        *     Request timed out.
  7    14 ms     *       18 ms  119.63.129.237
  8     *        *        *     Request timed out.
  9     *       45 ms     *     110.93.254.40
 10     *        *        *     Request timed out.
 11    30 ms     *       35 ms  216.239.48.87
 12     *        *       36 ms  72.14.239.49
 13    25 ms    25 ms    23 ms  mct01s20-in-f4.1e100.net [142.250.181.164]

Trace complete.
```

- **Task 4:** Analyze the results:
  - Identify the number of hops to the destination.
  - Note any delays or timeouts and discuss what they might indicate about the network path.
- **Task 5:** Use the tool to trace the path to another destination, such as a local server or an external website. Compare the results and discuss any differences in the number of hops or latency.

```
Trace complete.

C:\Users\asadr>tracert www.yahoo.com

Tracing route to me-ycpi-cf-www.g06.yahoodns.net [87.248.119.252]
over a maximum of 30 hops:

  1     9 ms     8 ms     8 ms  172.16.245.1
  2    13 ms    13 ms    15 ms  172.16.250.254
  3     *        9 ms     *     172.16.251.1
  4     *       17 ms     *     121.52.154.130.pern.pk [121.52.154.130]
  5     *        *        *     Request timed out.
  6     *        *        *     Request timed out.
  7    17 ms     *        *     khi77.pie.net.pk [202.125.134.65]
  8     *       18 ms     *     10.253.4.72
  9     *        *        *     Request timed out.
 10   131 ms   148 ms     *     ge-1-3-0.pat1.dee.yahoo.com [80.81.192.115]
 11   167 ms     *      140 ms  et35.bas1-1-edg.deb.yahoo.com [66.196.64.195]
 12     *        *        *     Request timed out.
 13     *        *        *     Request timed out.
 14     *        *        *     Request timed out.
 15     *        *        *     Request timed out.
 16     *        *        *     Request timed out.
 17     *        *        *     Request timed out.
 18     *        *        *     Request timed out.
 19     *        *        *     Request timed out.
 20     *        *        *     Request timed out.
 21     *        *        *     Request timed out.
 22     *        *        *     Request timed out.
 23     *        *        *     Request timed out.
 24     *        *        *     Request timed out.
 25     *        *        *     Request timed out.
 26     *        *        *     Request timed out.
 27     *        *        *     Request timed out.
 28     *        *        *     Request timed out.
 29     *        *        *     Request timed out.
 30     *        *        *     Request timed out.

Trace complete.
```

Student Worksheet

1. **Ping Command**
   - Open the command prompt on one of the PCs.
   - Use the ping command to test connectivity to the other PC(s).
   - Record the results:
     - Were the pings successful? (Yes/No)
     - What is the average round-trip time?
2. **Traceroute Command**
   - Open the command prompt on one of the PCs.

- Use the traceroute (tracert) command to trace the path to the other PC(s).
- Record the results:
  - How many hops were there?
  - Were there any delays or timeouts?

3. **Analyzing Network Traffic**
   - Switch to simulation mode in Cisco Packet Tracer.
   - Capture the traffic during ping and traceroute commands.
   - Analyze the captured packets:
     - What information can you see in the packet details?
     - How does the data flow between the PCs?

Submission:

- Submit your completed worksheet with all tasks and observations recorded.
- Include screenshots of your network setup, command outputs, and Packet Tracer simulations.

---End---