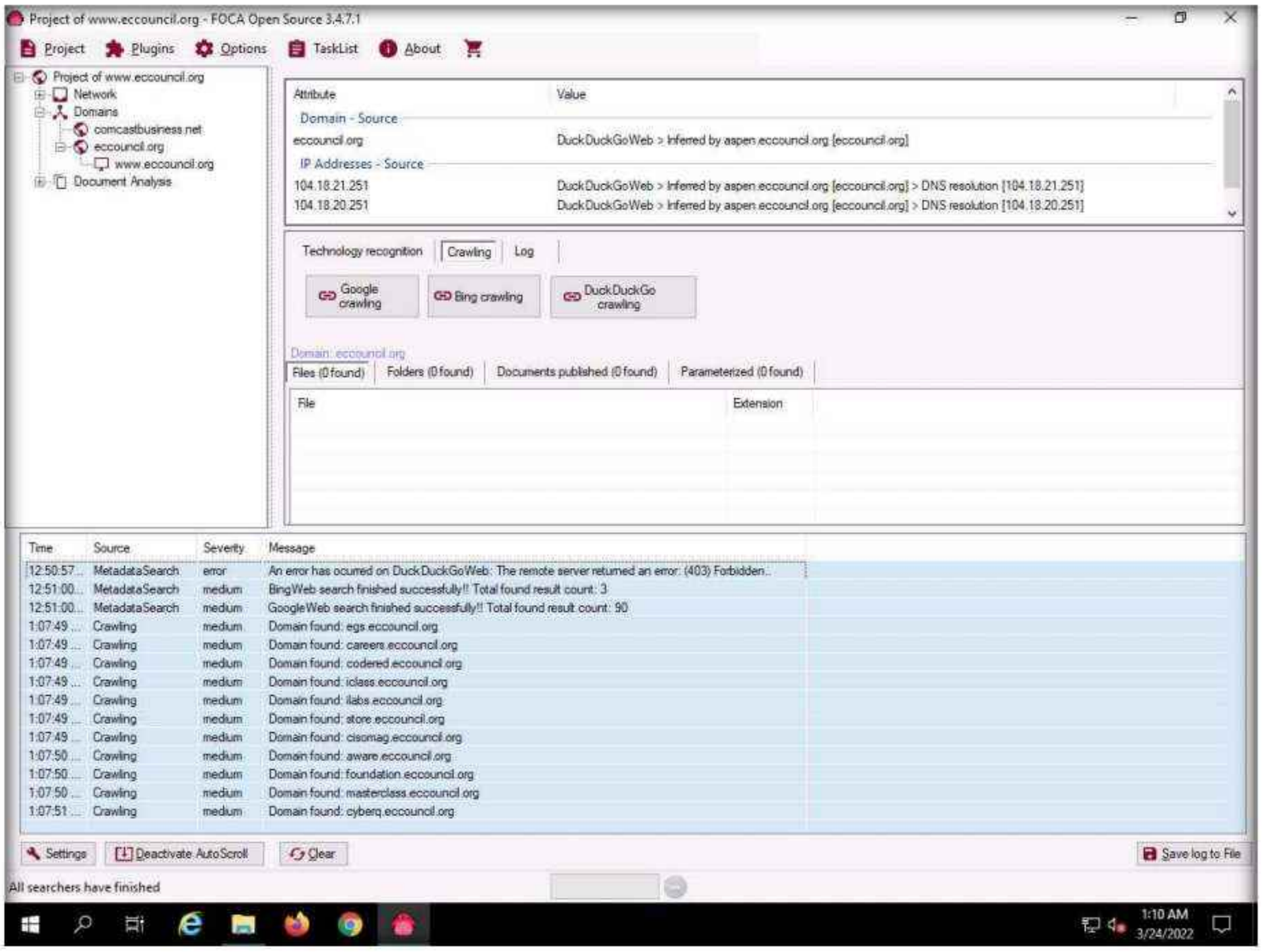
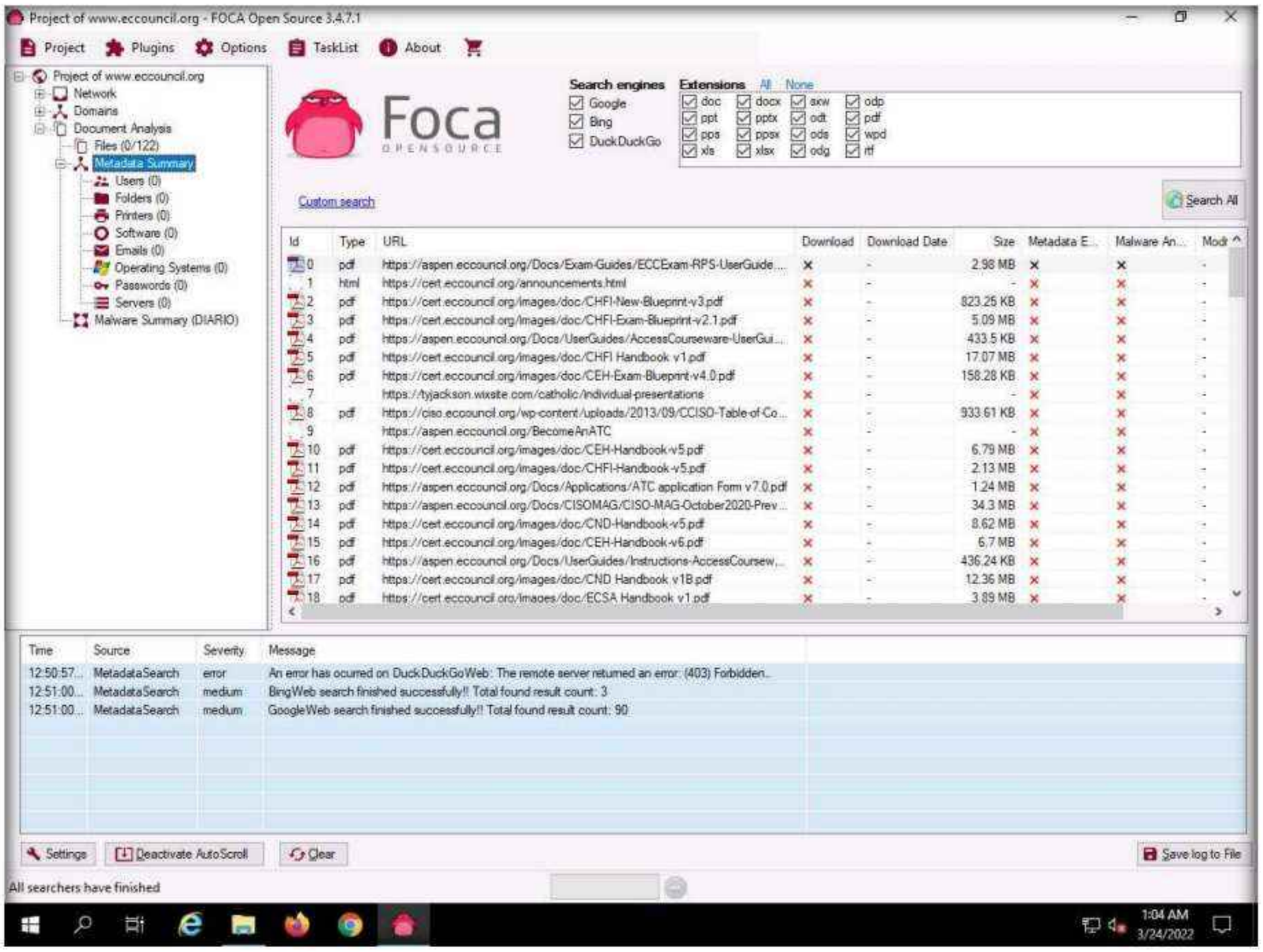
19. Google's crawling functionality begins crawling the target website. Once the crawling is completed, results appear in the lower pane.
20. The results include the domains obtained through scanning along with their severity as low, medium or high is displayed, as shown in the screenshot. Using this information, attackers can further find vulnerabilities in the target domain and exploit them to launch web application attacks.



21. Now, expand the **Document Analysis** node; further expand the **Metadata Summary** node. Here, information regarding users, folders, printers, software, etc. is displayed.

    Note: The domain we used does not have information associated with metadata summary.



22. This concludes the demonstration of gathering useful information about the target organization using the FOCA tool.
23. Close all open windows and document all the acquired information.
24. Turn off the **Windows Server 2019** virtual machine.

Task 5: Footprinting a Target using BillCipher

BillCipher is an information gathering tool for a Website or IP address. Using this tool, you can gather information such as DNS Lookup, Whois lookup, GeoIP Lookup, Subnet Lookup, Port Scanner, Page Links, Zone Transfer, HTTP Header, etc.

Here, we will use the BillCipher tool to footprint a target website URL.

Note: Here, we will consider **www.certifiedhacker.com** as a target website. However, you can select a target domain of your choice.

1. Switch to the **Parrot Security** virtual machine. Click the **MATE Terminal** icon at the top-left corner of the **Desktop** to open a **Terminal** window.
2. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
3. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.
4. In the **Parrot Terminal** window, type **cd BillCipher** and press **Enter** to navigate to the BillCipher directory.

5. Now, type **python3 billcipher.py** and press **Enter** to launch the application.

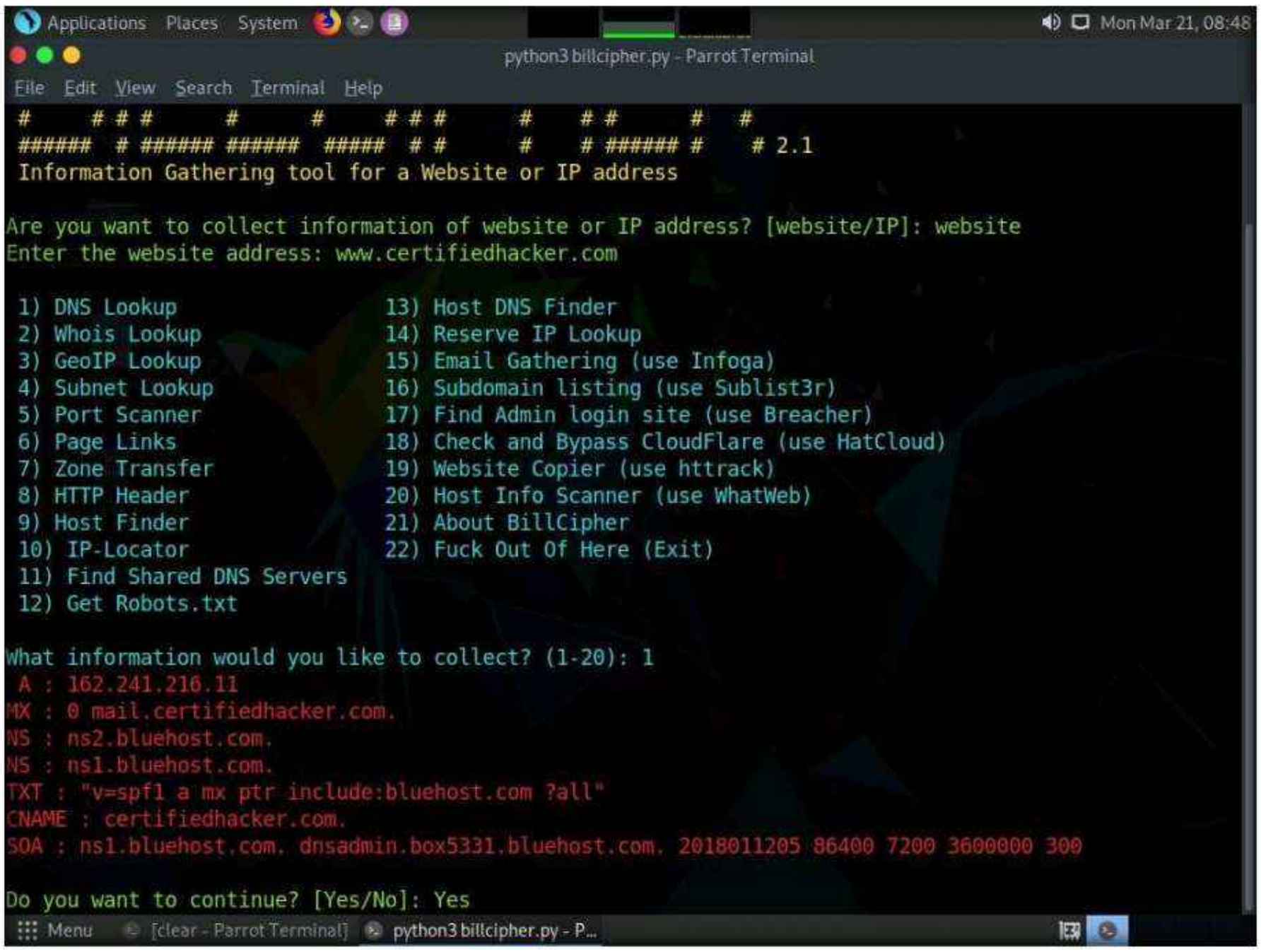
6. BillCipher application initializes. In the **Are you want to collect information of website or IP address?** option, type **website** and press **Enter**.

7. In the **Enter the website address** option, type the target website URL (here, **www.certifiedhacker.com**) and press **Enter**.

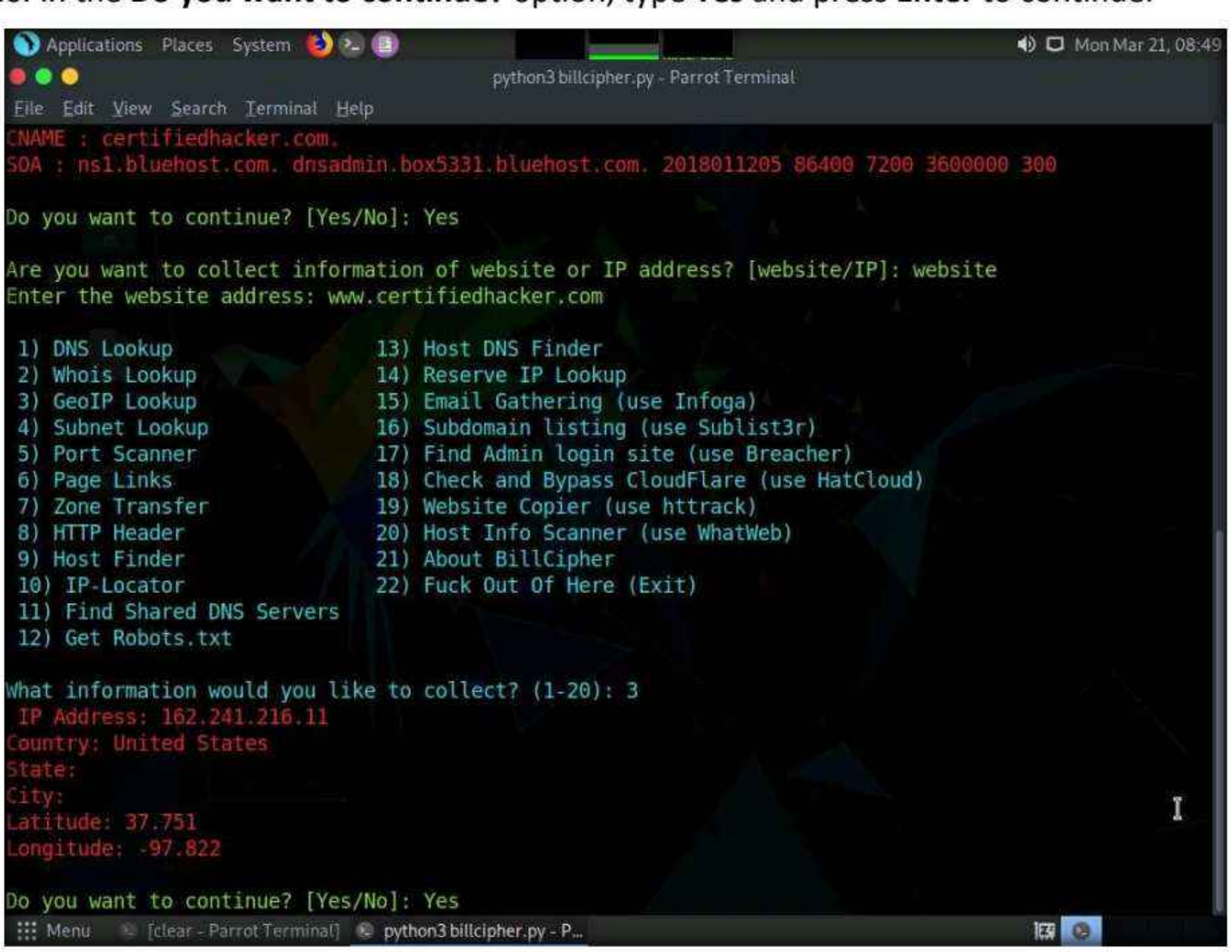
8. BillCipher displays various available options that you can use to gather information regarding a target website.

9. In the **What information would you like to collect?** option, type **1** to choose the **DNS Lookup** option and press **Enter**.

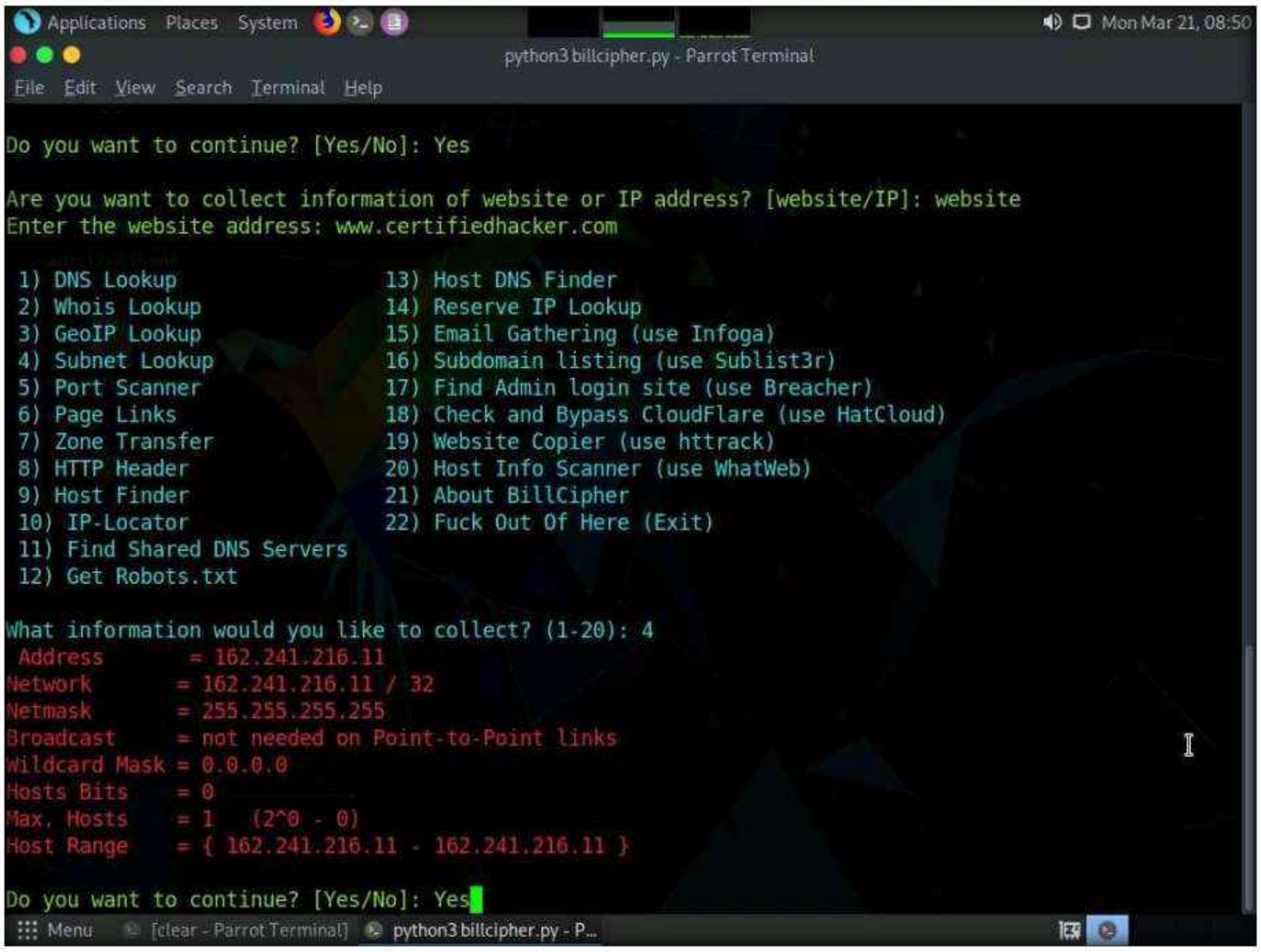
10. The result appears, displaying the DNS information regarding the target website, as shown in the screenshot.
11. In the **Do you want to continue?** option, type **Yes** and press **Enter** to continue.



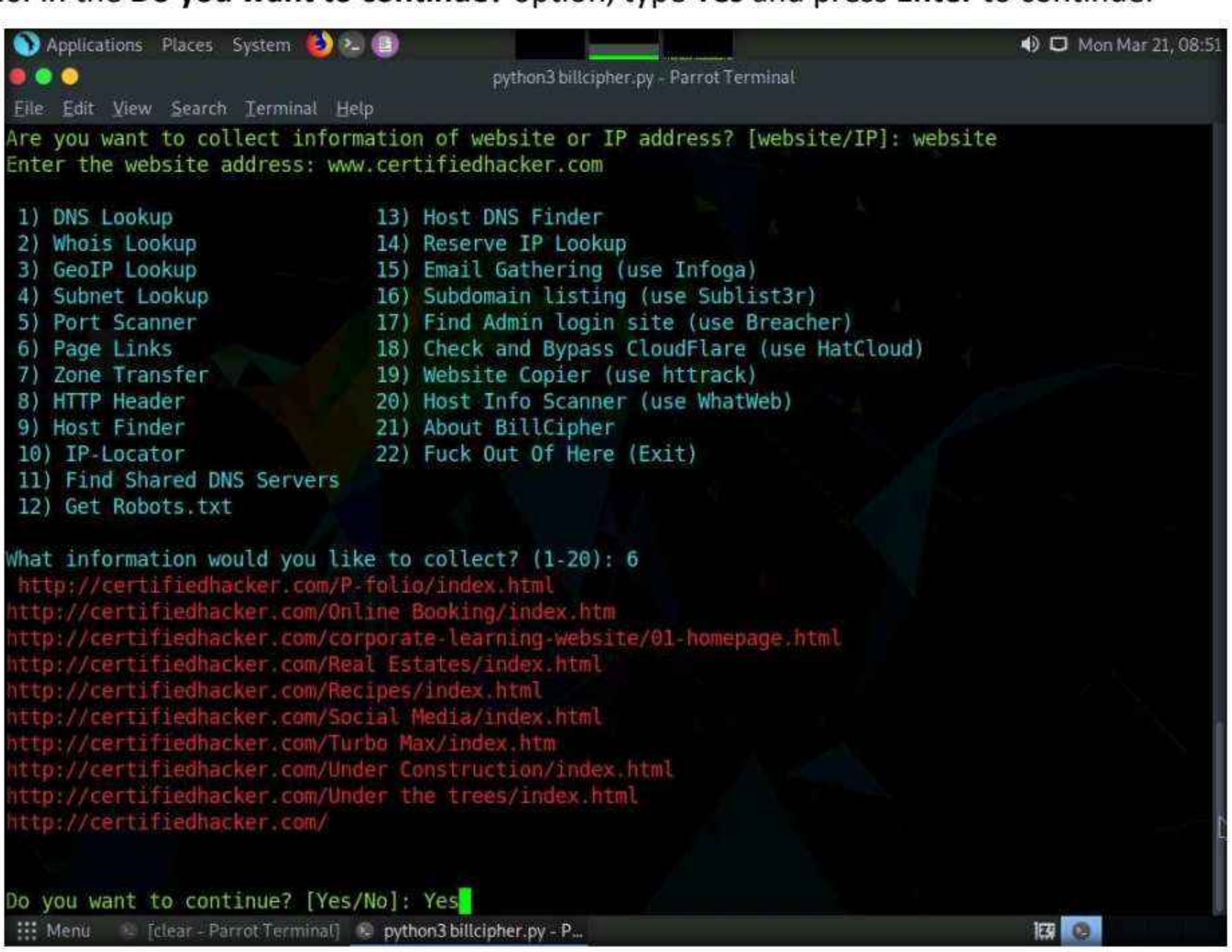
12. **Are you want to collect information of website or IP address?** option appears, type **website** and press **Enter**.
13. In the **Enter the website address** option, type the target website URL (here, **www.certifiedhacker.com**) and press **Enter**.
14. Now, type **3** and press **Enter** to choose the **GeoIP Lookup** option from the available information gathering options.
15. The result appears, displaying the **GeoIP Lookup** information of the target website, as shown in the screenshot.
16. In the **Do you want to continue?** option, type **Yes** and press **Enter** to continue.



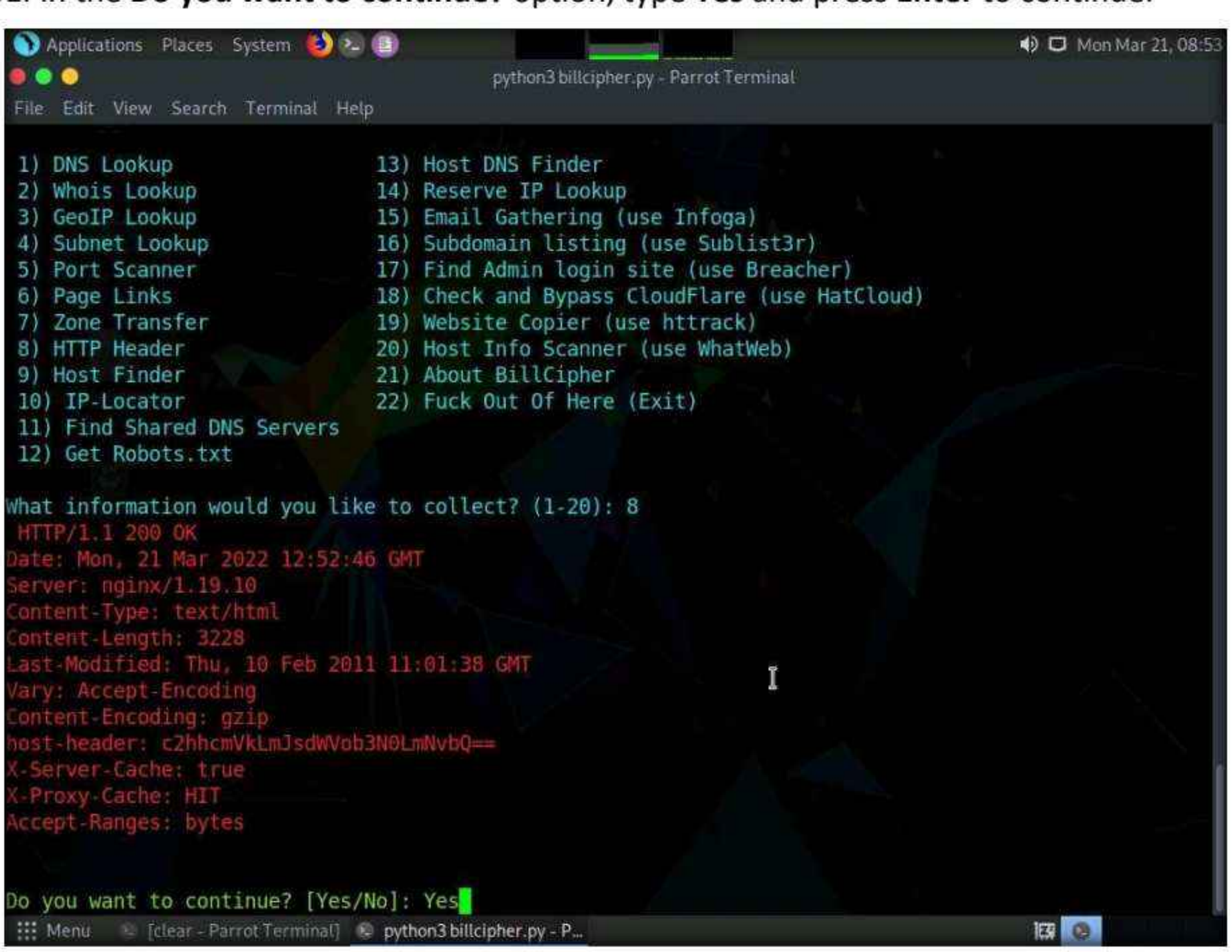
17. **Are you want to collect information of website or IP address?** option appears, type **website** and press **Enter**.
18. In the **Enter the website address** option, type the target website URL (here, **www.certifiedhacker.com**) and press **Enter**.
19. Now, type **4** and press **Enter** to choose the **Subnet Lookup** option from the available information gathering options.
20. The result appears, displaying the **Subnet Lookup** information of the target website.
21. In the **Do you want to continue?** option, type **Yes** and press **Enter** to continue.



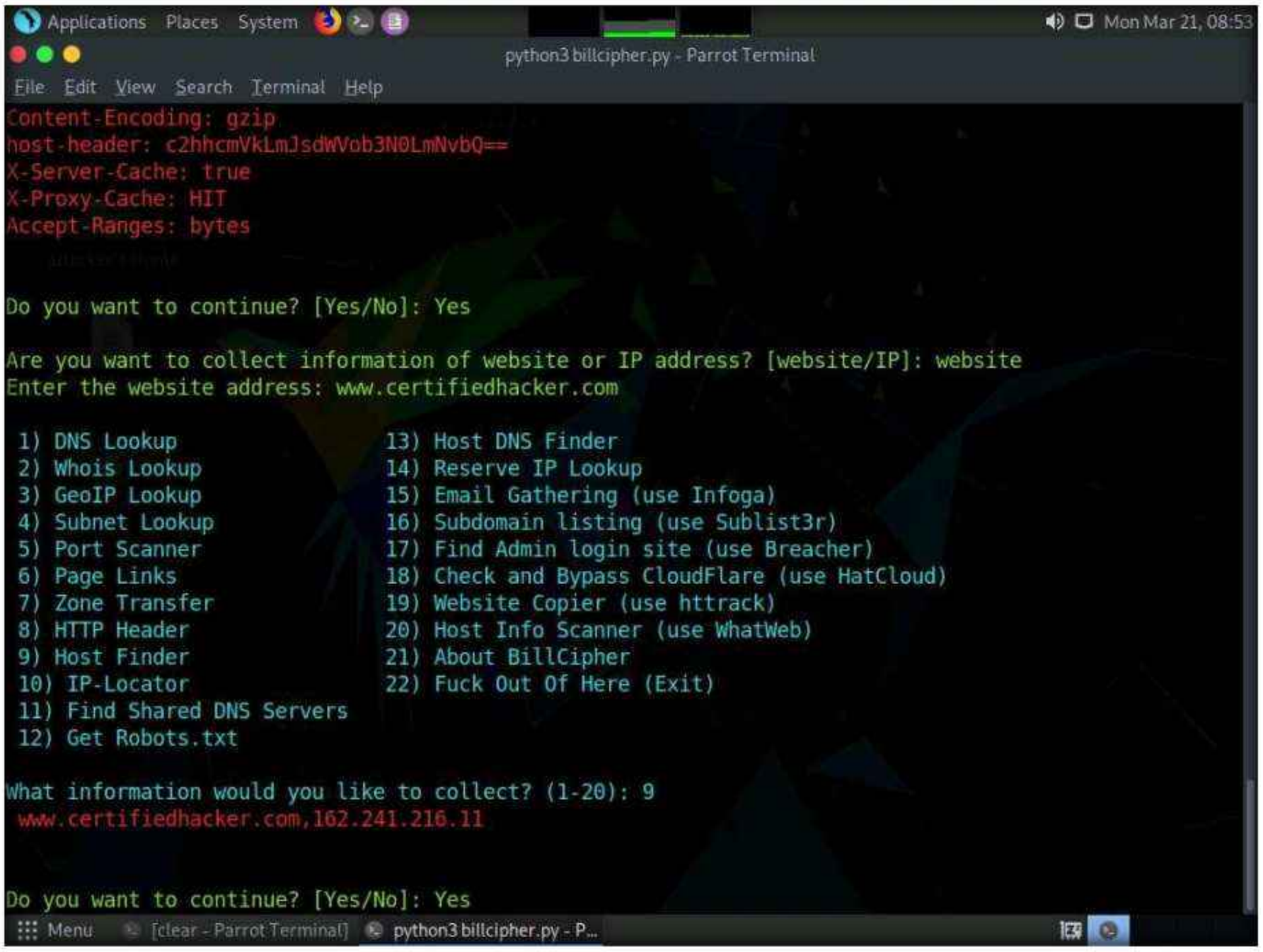
22. **Are you want to collect information of website or IP address?** option appears, type **website** and press **Enter**.
23. In the **Enter the website address** option, type the target website URL (here, **www.certifiedhacker.com**) and press **Enter**.
24. Now, type **6** and press **Enter** to choose the **Page Links** option from the available information gathering options.
25. The result appears, displaying a list of **Visible links** and **Hidden links** of the target website, as shown in the screenshot.
26. In the **Do you want to continue?** option, type **Yes** and press **Enter** to continue.



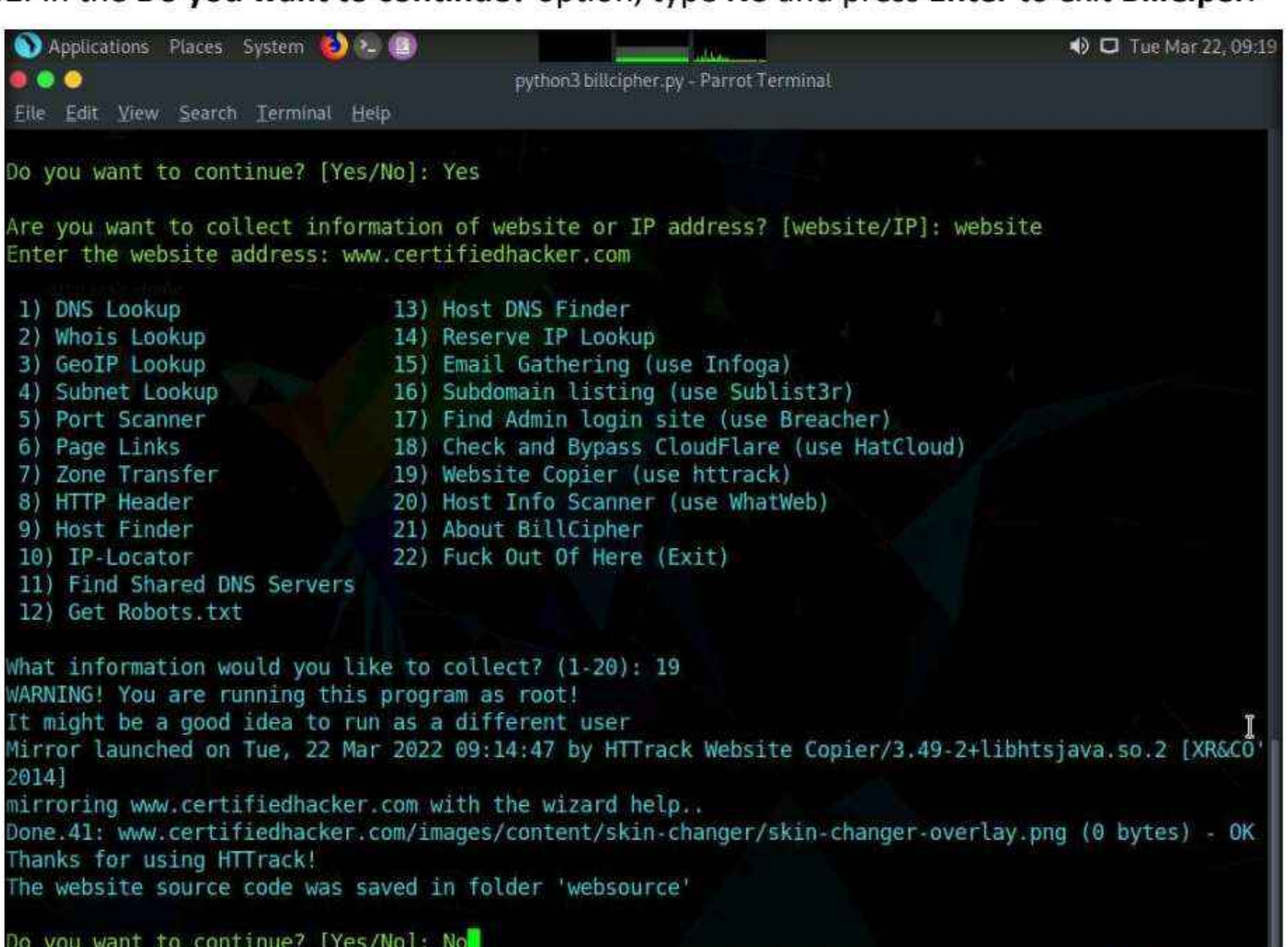
27. **Are you want to collect information of website or IP address?** option appears, type **website** and press **Enter**.
28. In the **Enter the website address** option, type the target website URL (here, **www.certifiedhacker.com**) and press **Enter**.
29. Now, type **8** and press **Enter** to choose the **HTTP Header** option from the available information gathering options.
30. The result appears, displaying information regarding the HTTP header of the target website, as shown in the screenshot.
31. In the **Do you want to continue?** option, type **Yes** and press **Enter** to continue.



32. **Are you want to collect information of website or IP address?** option appears, type **website** and press **Enter**.
33. In the **Enter the website address** option, type the target website URL (here, **www.certifiedhacker.com**) and press **Enter**.
34. Now, type **9** and press **Enter** to choose **Host Finder** option from the available information gathering option.
35. The result appears, displaying information regarding the IP address of the target website, as shown in the screenshot.3
36. In the **Do you want to continue?** option, type **Yes** and press **Enter** to continue.

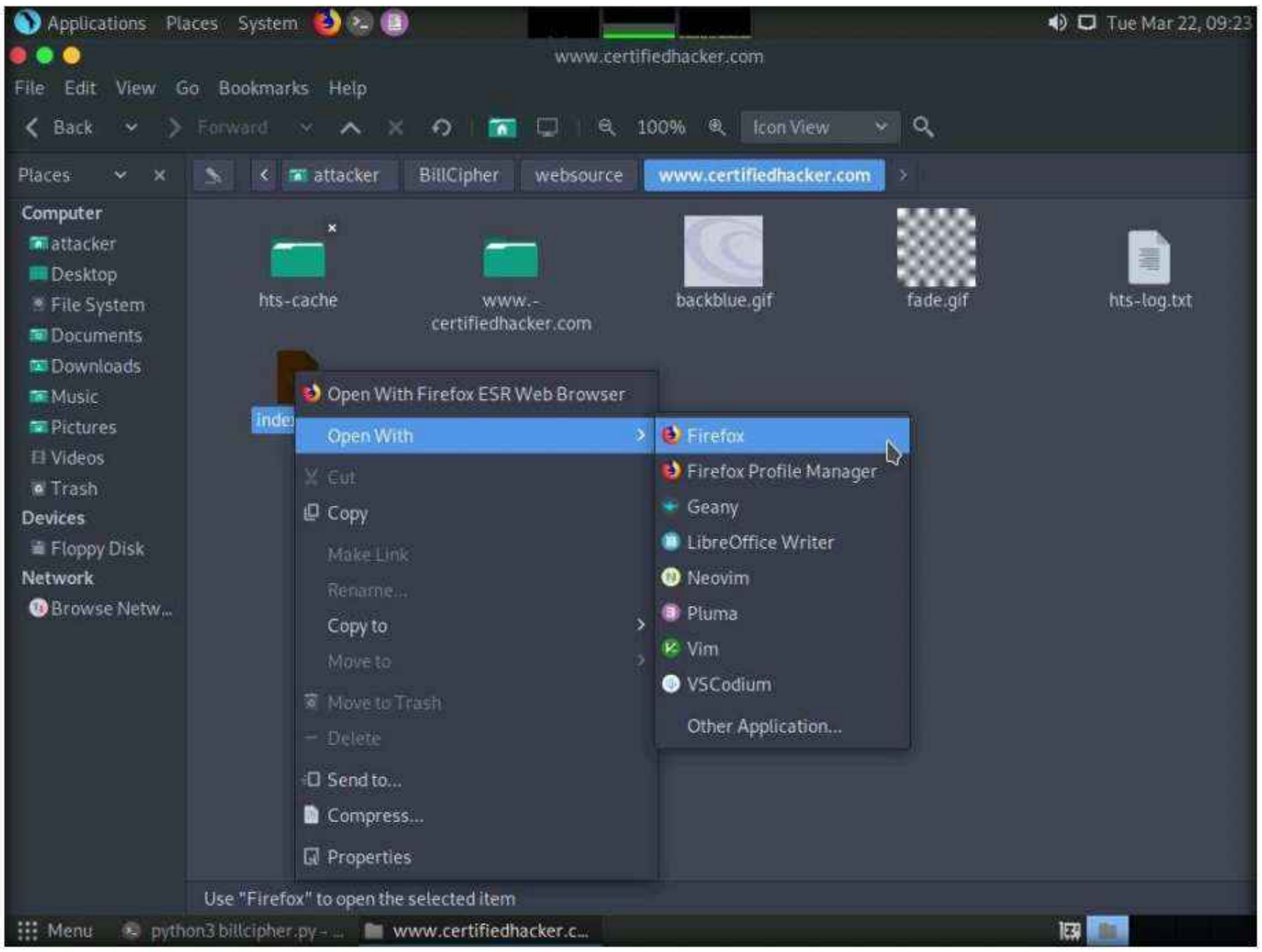


37. **Are you want to collect information of website or IP address?** option appears, type **website** and press **Enter**.
38. In the **Enter the website address** option, type the target website URL (here, **www.certifiedhacker.com**) and press **Enter**.
39. Now, type **19** and press **Enter** to choose the **Website Copier (use httrack)** option from the available information gathering options.
40. The tool starts mirroring the target website; this will take approximately 5 minutes.
41. After completion of the mirroring process, the mirrored website gets saved in the folder **websource**, as shown in the screenshot.
42. In the **Do you want to continue?** option, type **No** and press **Enter** to exit **BillCiper**.

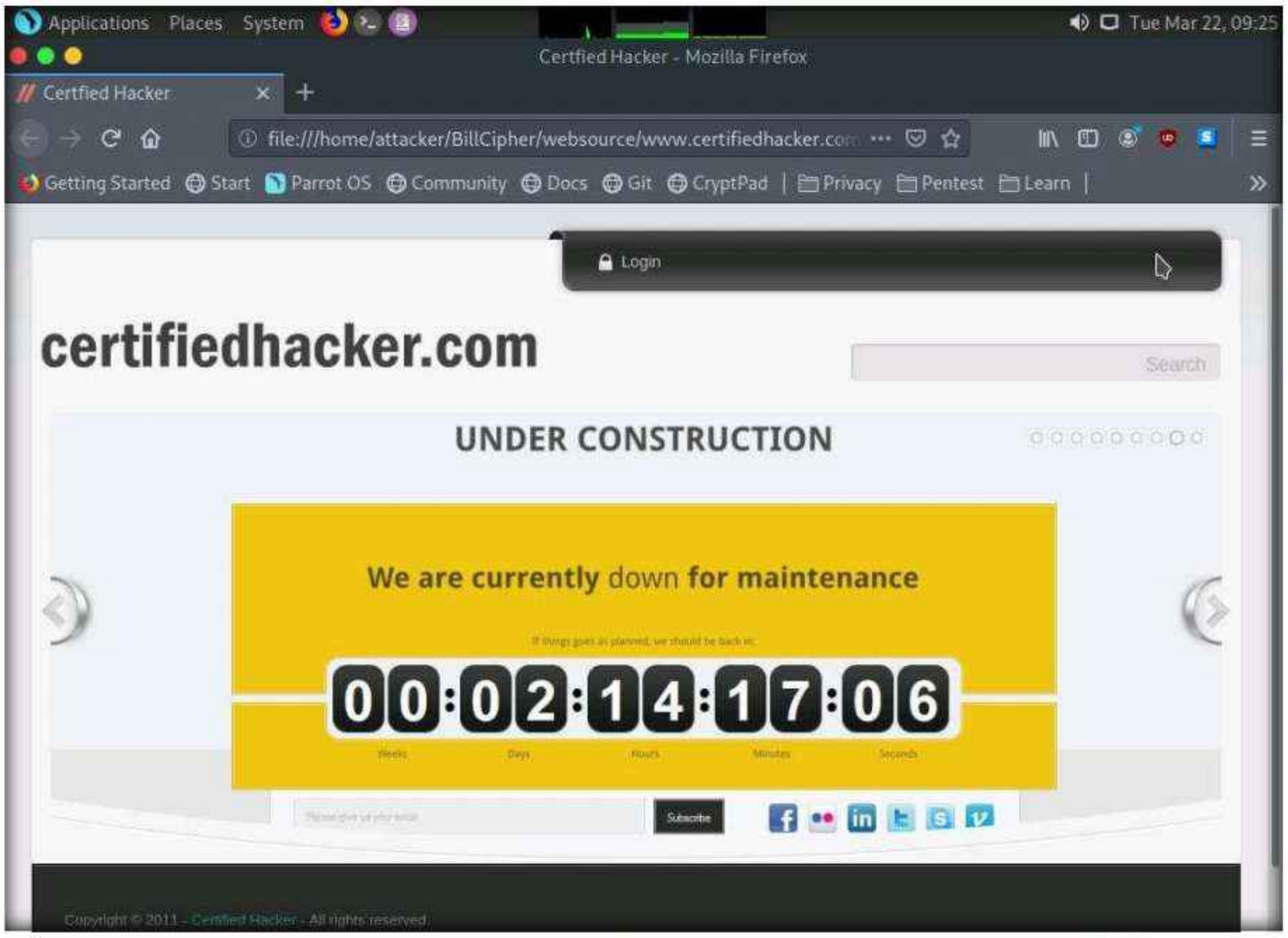


43. Now, click **Places** from the top section of the **Desktop** and click **Home Folder** from the context menu.

44. The **attacker** window appears, navigate to **BillCipher** --> **websource** --> **www.certifiedhacker.com** --> **www.certifiedhacker.com**. Right-click the **index.html** file and navigate to **Open With** --> **Firefox** to open the mirrored website.



45. The mirror target website (**www.certifiedhacker.com**) appears in the **Mozilla Firefox** browser, as shown in the screenshot.



46. Similarly, you can use other information gathering options to gather information about the target.
47. This concludes the demonstration of footprinting the target website URL using BillCipher.
48. Close all open windows and document all the acquired information.
49. Turn off the **Parrot Security** virtual machine.

Task 6: Footprinting a Target using OSINT Framework

OSINT Framework is an open-source intelligence gathering framework that helps security professionals for performing automated footprinting and reconnaissance, OSINT research, and intelligence gathering. It is focused on gathering information from free tools or resources. This framework includes a simple web interface that lists various OSINT tools arranged by category and is shown as an OSINT tree structure on the web interface.

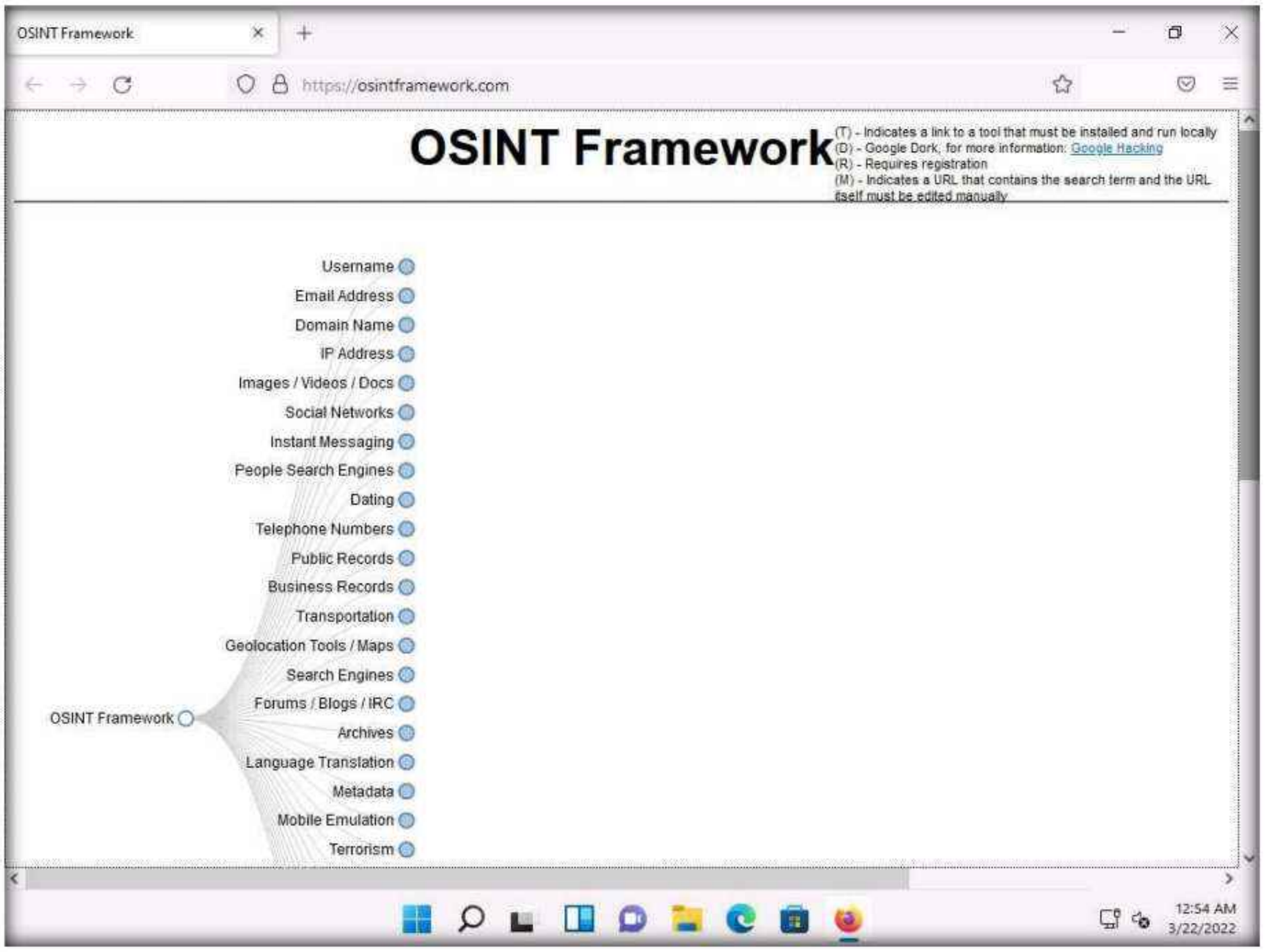
The OSINT Framework includes the following indicators with the available tools:

- (T) - Indicates a link to a tool that must be installed and run locally
- (D) - Google Dork

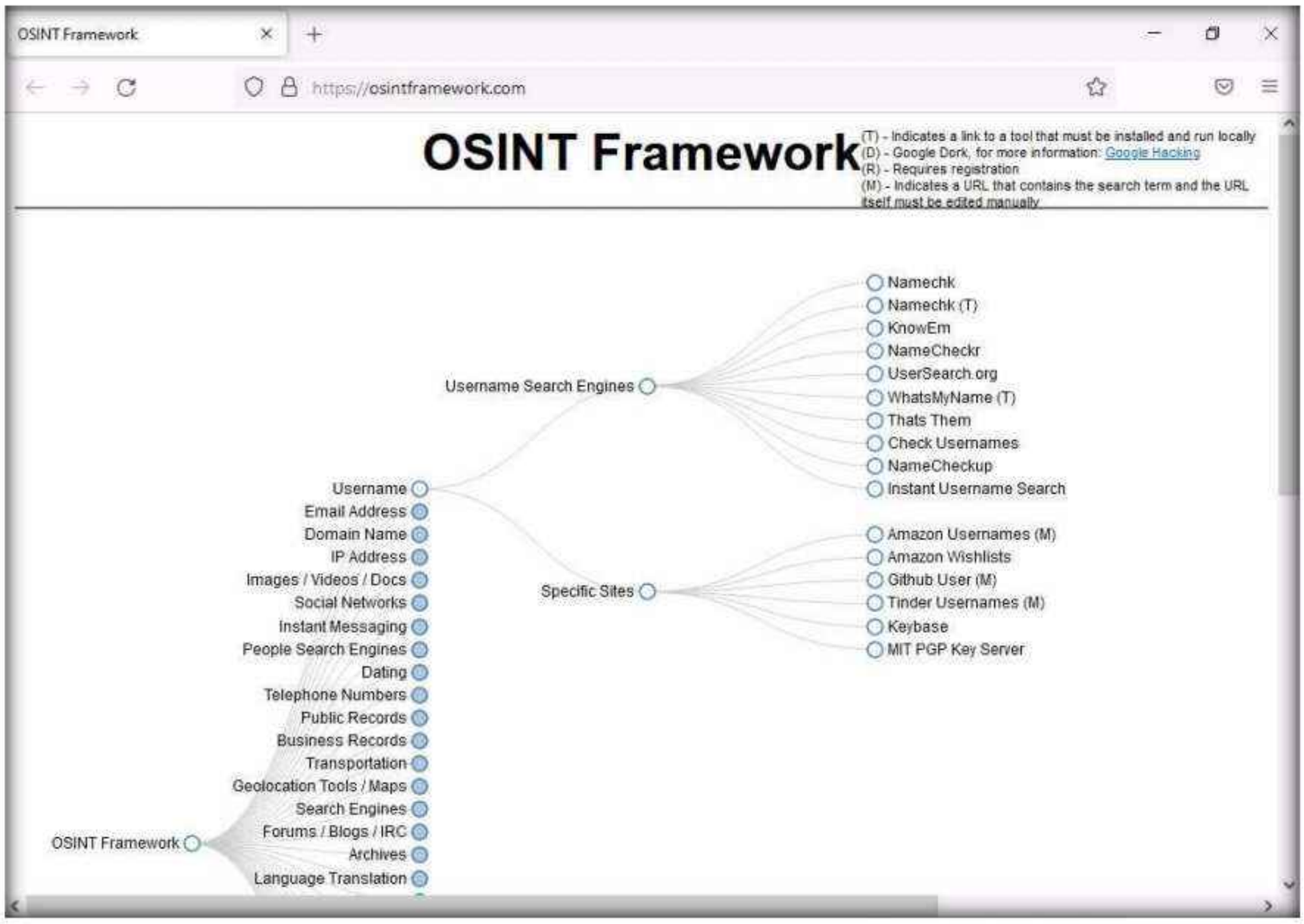
- (R) - Requires registration
- (M) - Indicates a URL that contains the search term and the URL itself must be edited manually

Here, we will use the OSINT Framework to explore footprinting categories and associated tools.

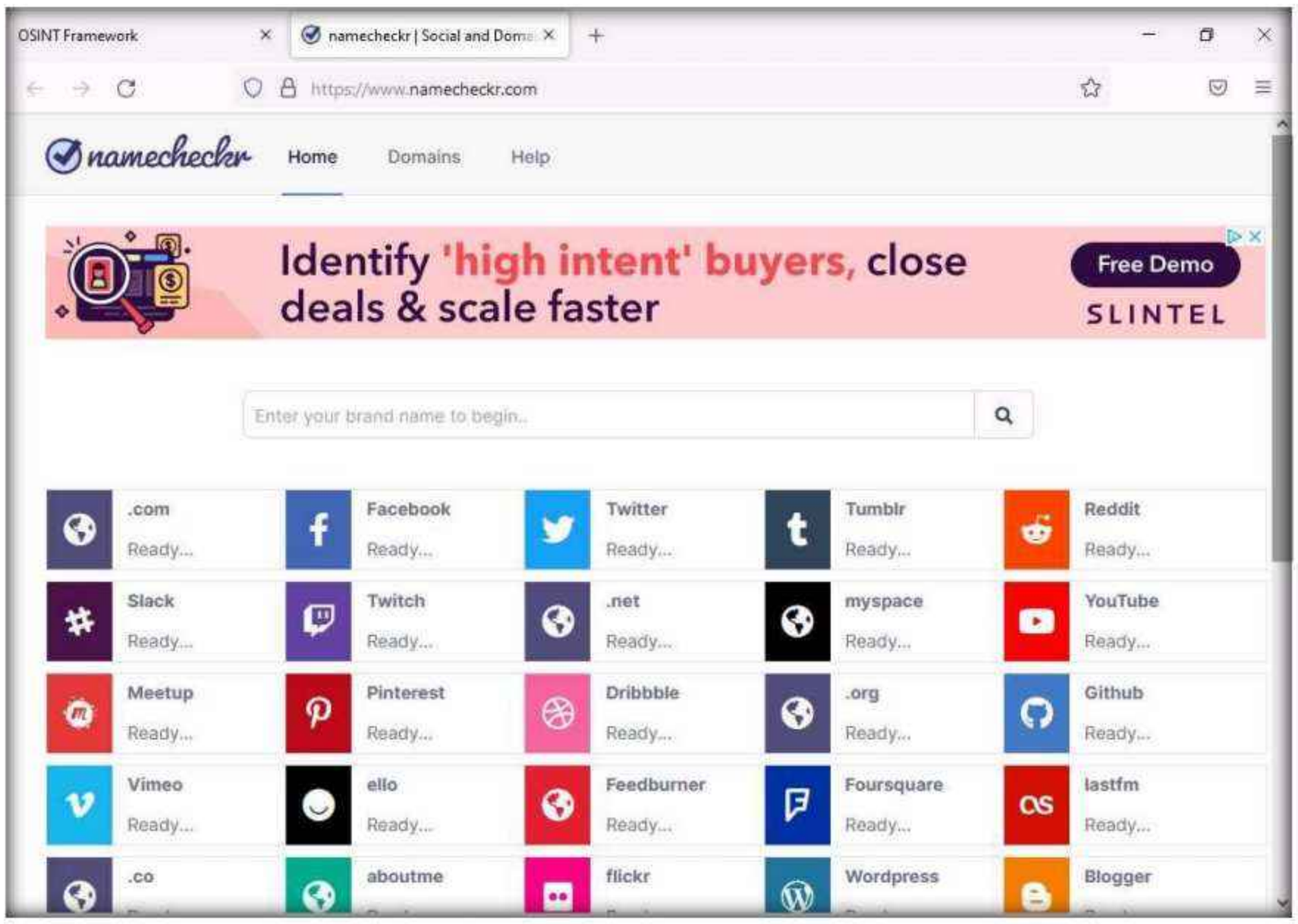
1. Switch to the **Windows 11** virtual machine.
2. Open any web browser (here, **Mozilla Firefox**). In the address bar of the browser place your mouse cursor, type **https://osintframework.com/** and press **Enter**.
3. **OSINT Framework** website appears; you can observe the OSINT tree on the left side of screen, as shown in the screenshot.



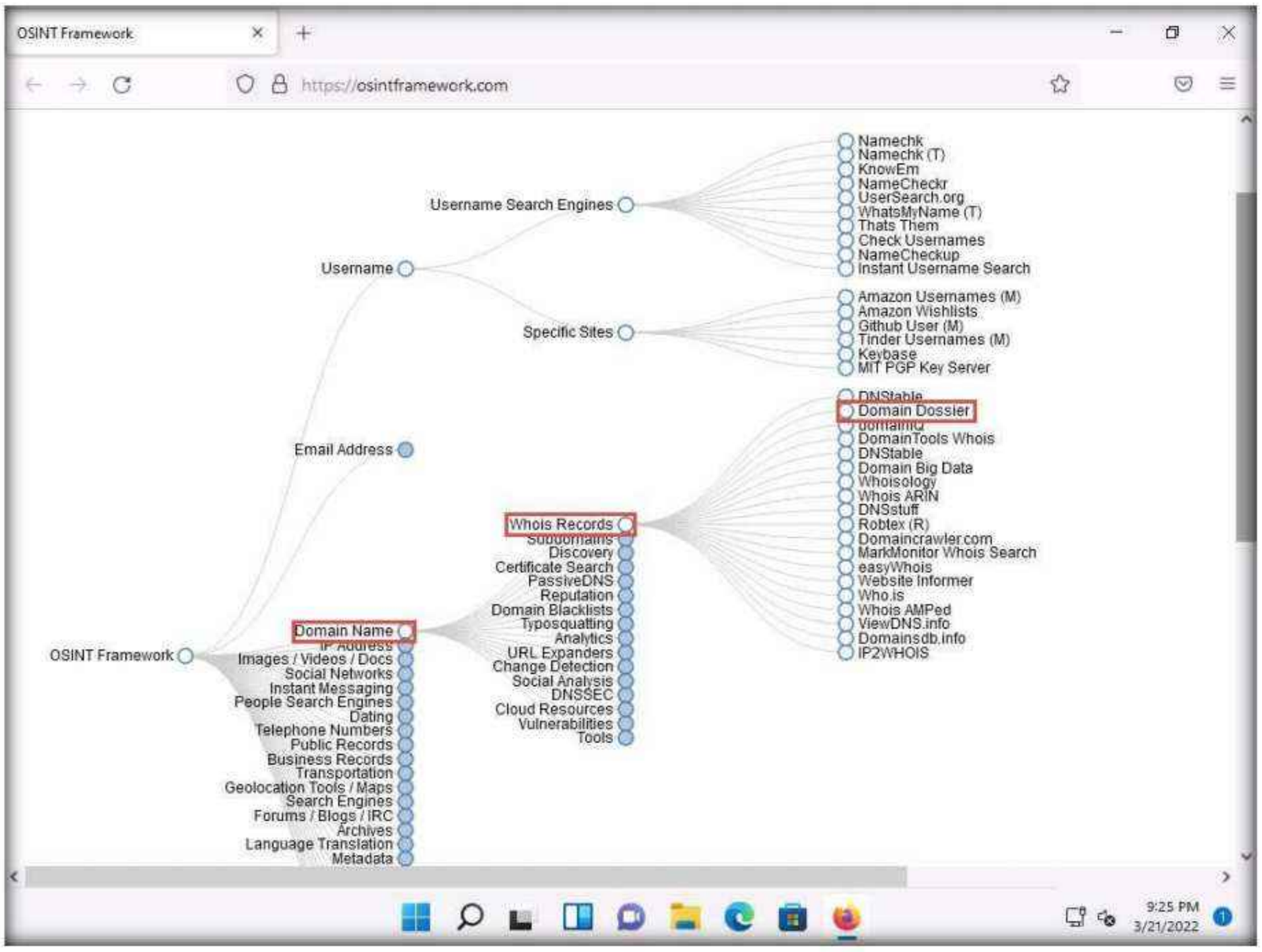
4. Clicking on any of the categories such as **Username**, **Email Address**, or **Domain Name** will make many useful resources appear on the screen in the form of a sub-tree.
5. Click the **Username** category and click to expand the **Username Search Engines** and **Specific Sites** sub-categories.
6. You can observe a list of OSINT tools filtered by sub-categories (**Username Search Engines** and **Specific Sites** sub-categories).



7. From the list of available tools under the **Username Search Engines** category, click on the **NameCheckr** tool to navigate to the **NameCheckr** website.
8. The **NameCheckr** website appears, as shown in the screenshot.

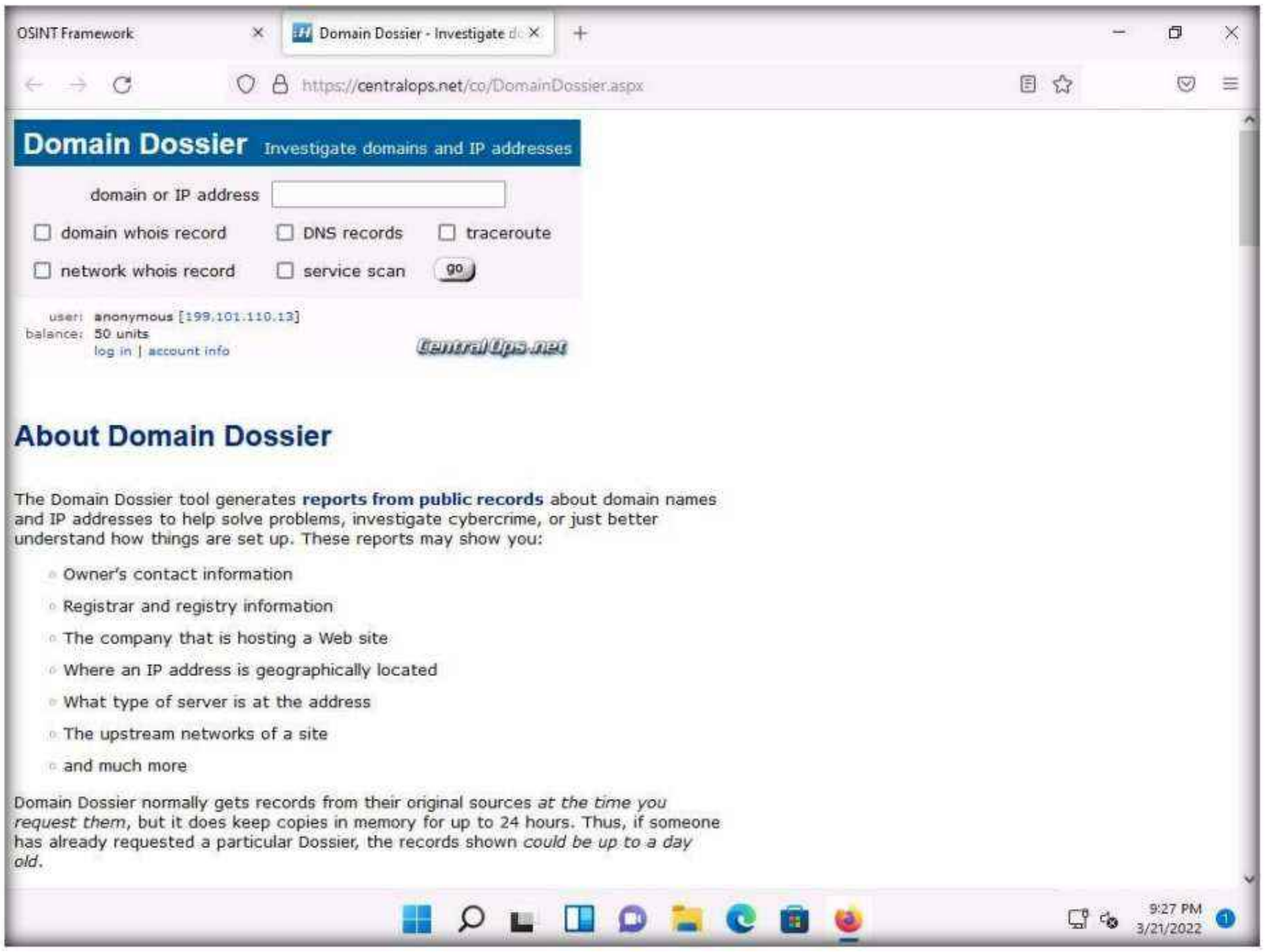


9. Close the current tab to navigate back to the OSINT Framework webpage.
10. Similarly, you can explore other tools from the list of mentioned tools under the **Username Search Engines** and **Specific Sites** sub-categories.
11. Now, click the **Domain Name** category, and its sub-categories appear. Click to expand the **Whois Records** sub-category.
12. A list of tools under the **Whois Records** sub-category appears; click the **Domain Dossier** tool.



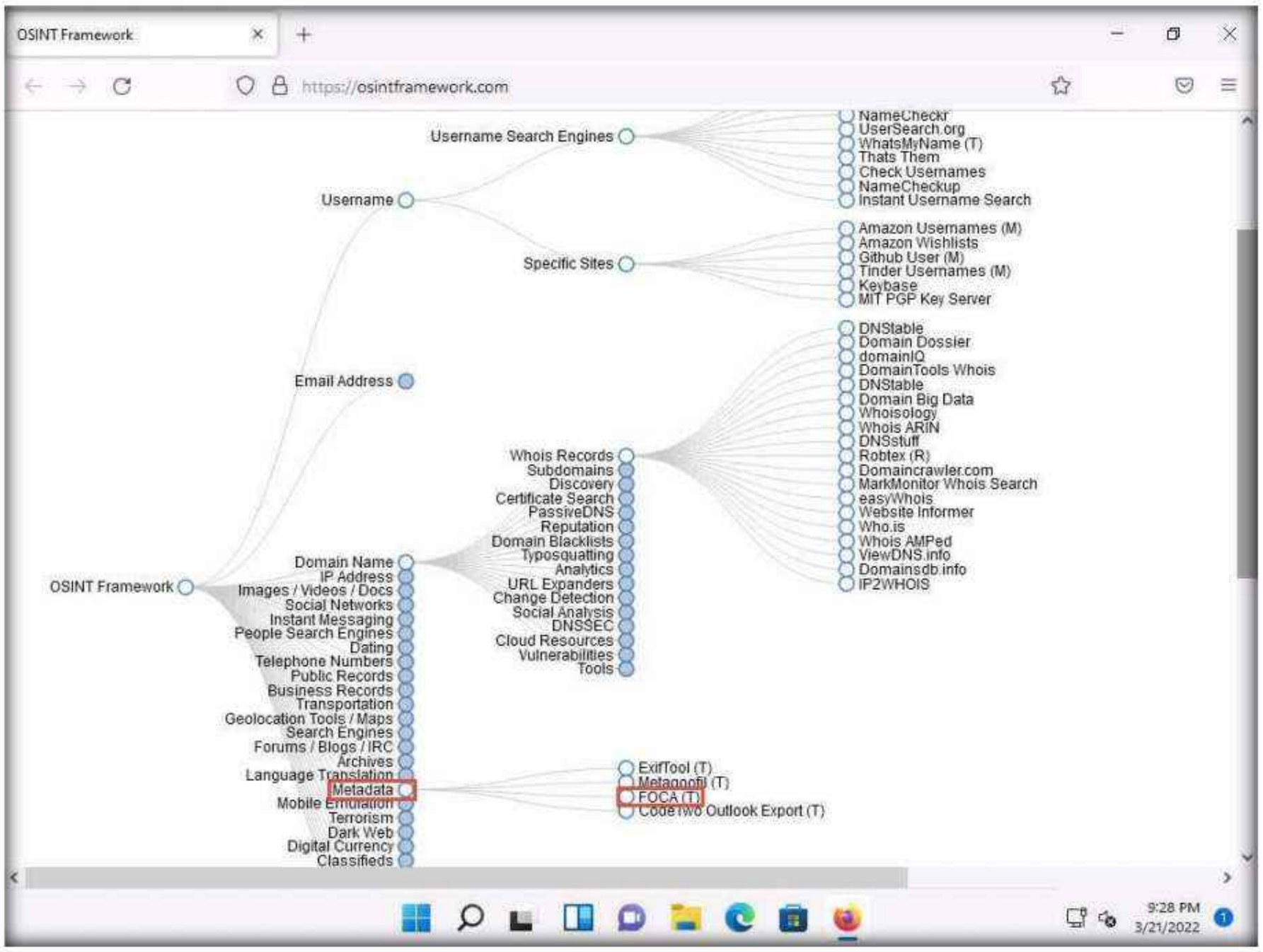
13. The **Domain Dossier** website appears, as shown in the screenshot.

Note: The Domain Dossier tool generates reports from public records about domain names and IP addresses to help solve problems, investigate cybercrime, or just to better understand how things are set up.

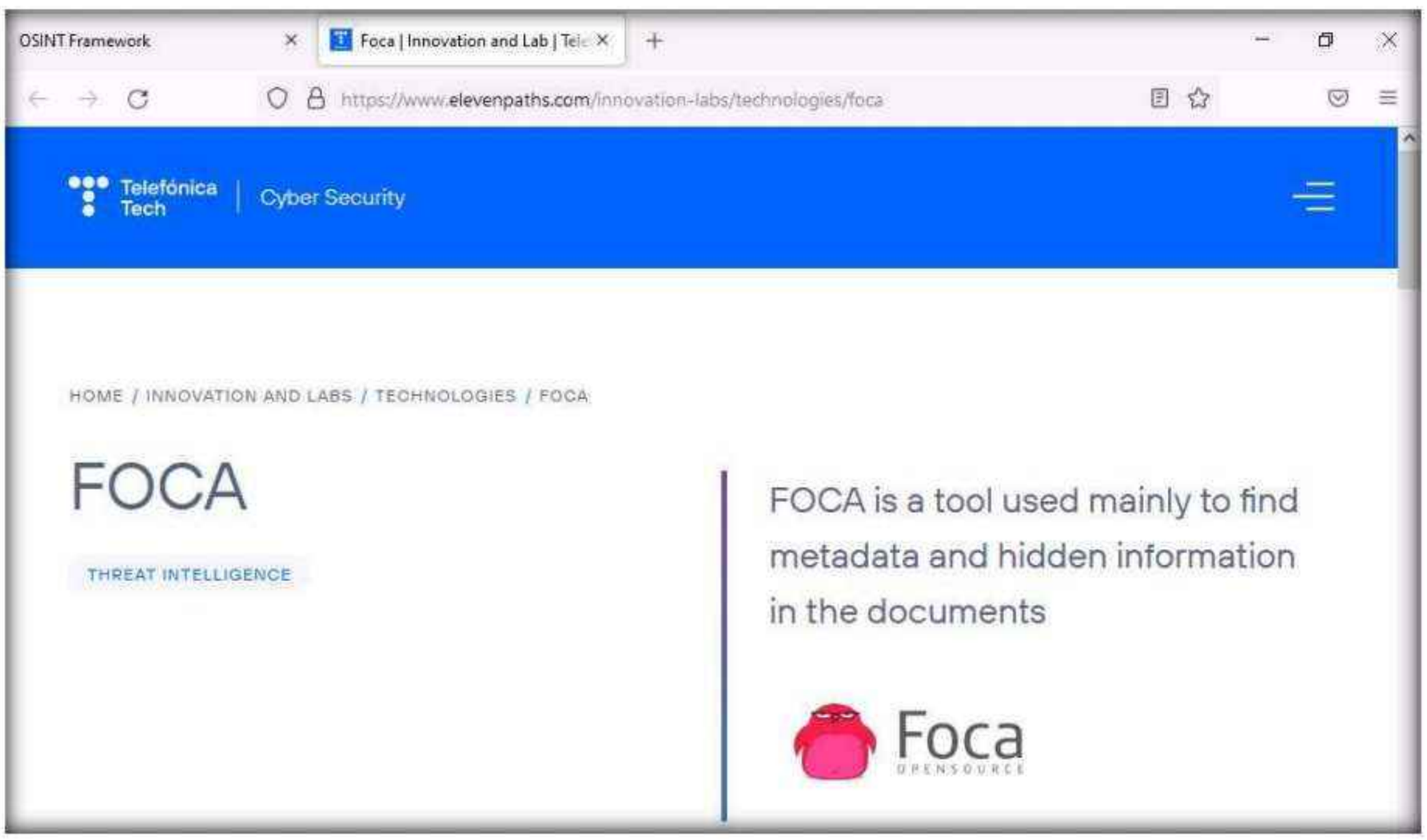


14. Close the current tab to navigate back to the **OSINT Framework** webpage.

15. Now, click the **Metadata** category and click the **FOCA** tool from a list of available tools.



16. The **FOCA** website appears, displaying information about the tool along with its download link, as shown in the screenshot.



17. Similarly, you can explore other available categories such as **Email Address**, **IP Address**, **Social Networks**, **Instant Messaging**, etc. and the tools associated with each category. Using these tools, you can perform footprinting on the target organization.
18. This concludes the demonstration of performing footprinting using the OSINT Framework.
19. You can also use footprinting tools such as **Recon-Dog** (https://www.github.com), **Grecon** (https://github.com), **Th3Inspector** (https://github.com), **Raccoon** (https://github.com), **Orb** (https://github.com), etc. to gather additional information related to the target company.
20. Close all open windows and document all the acquired information.
21. Turn off the **Windows 11** virtual machine.

Lab Analysis

Analyze and document the results of this lab exercise.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Internet Connection Required	
☑ Yes	☐ No
Platform Supported	
☑ Classroom	☑ CyberQ

Scanning Networks

Module 03

Scanning Networks

Network scanning refers to a set of procedures performed to identify the hosts, ports, and services running in a network.

Lab Scenario

Earlier, you gathered all possible information about the target such as organization information (employee details, partner details, web links, etc.), network information (domains, sub-domains, sub sub-domains, IP addresses, network topology, etc.), and system information (OS details, user accounts, passwords, etc.).

Now, as an ethical hacker, or as a penetration tester (hereafter, pen tester), your next step will be to perform port scanning and network scanning on the IP addresses that you obtained in the information-gathering phase. This will help you to identify an entry point into the target network.

Scanning itself is not the actual intrusion, but an extended form of reconnaissance in which the ethical hacker and pen tester learns more about the target, including information about open ports and services, OSes, and any configuration lapses. The information gleaned from this reconnaissance helps you to select strategies for the attack on the target system or network.

This is one of the most important phases of intelligence gathering, which enables you to create a profile of the target organization. In the process of scanning, you attempt to gather information, including the specific IP addresses of the target system that can be accessed over the network (live hosts), open ports, and respective services running on the open ports and vulnerabilities in the live hosts.

Port scanning will help you identify open ports and services running on specific ports, which involves connecting to Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) system ports. Port scanning is also used to discover the vulnerabilities in the services running on a port.

The labs in this module will give you real-time experience in gathering information about the target organization using various network scanning and port scanning techniques.

Lab Objective

The objective of this lab is to conduct network scanning, port scanning, analyzing the network vulnerabilities, etc.

Network scans are needed to:

- Check live systems and open ports
- Identify services running in live systems
- Perform banner grabbing/OS fingerprinting
- Identify network vulnerabilities

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2022 virtual machine
- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Ubuntu virtual machine
- Android virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 130 Minutes

Overview of Scanning Networks

Network scanning is the process of gathering additional detailed information about the target by using highly complex and aggressive reconnaissance techniques. The purpose of scanning is to discover exploitable communication channels, probe as many listeners as possible, and keep track of the responsive ones.

Types of scanning:

- **Port Scanning**: Lists open ports and services
- **Network Scanning**: Lists the active hosts and IP addresses
- **Vulnerability Scanning**: Shows the presence of known weaknesses

Lab Tasks

Ethical hackers and pen testers use numerous tools and techniques to scan the target network. Recommended labs that will assist you in learning various network scanning techniques include:

Lab No.	Lab Exercise Name	Core*	Self-study**	CyberQ ***
1	Perform Host Discovery	√	√	√
	1.1 Perform Host Discovery using Nmap	√		√
	1.2 Perform Host Discovery using Angry IP Scanner		√	√
2	Perform Port and Service Discovery	√	√	√
	2.1 Perform Port and Service Discovery using MegaPing		√	√
	2.2 Perform Port and Service Discovery using NetScanTools Pro		√	√

	2.3 Perform Port Scanning using sx Tool		√	√
	2.4 Explore Various Network Scanning Techniques using Nmap	√		√
	2.5 Explore Various Network Scanning Techniques using Hping3		√	√
3	Perform OS Discovery	√	√	√
	3.1 Identify the Target System's OS with Time-to-Live (TTL) and TCP Window Sizes using Wireshark		√	√
	3.2 Perform OS Discovery using Nmap Script Engine (NSE)	√		√
	3.3 Perform OS Discovery using Unicornscan		√	√
4	Scan beyond IDS and Firewall	√	√	√
	4.1 Scan beyond IDS/Firewall using various Evasion Techniques	√		√
	4.2 Create Custom Packets using Colasoft Packet Builder to Scan beyond IDS/Firewall		√	√
	4.3 Create Custom UDP and TCP Packets using Hping3 to Scan beyond IDS/Firewall	√		√
	4.4 Browse Anonymously using Proxy Switcher		√	
	4.5 Browse Anonymously using CyberGhost VPN		√	
5	Perform Network Scanning using Various Scanning Tools	√		√
	5.1 Scan a Target Network using Metasploit	√		√

Remark

EC-Council has prepared a considered amount of lab exercises for student to practice during the 5-day class and at their free time to enhance their knowledge and skill.

***Core** - Lab exercise(s) marked under Core are recommended by EC-Council to be practised during the 5-day class.

****Self-study** - Lab exercise(s) marked under self-study is for students to practise at their free time. Steps to access the additional lab exercises can be found in the first page of CEHv12 volume 1 book.

*****CyberQ** - Lab exercise(s) marked under CyberQ are available in our CyberQ solution. CyberQ is a cloud-based virtual lab environment preconfigured with vulnerabilities, exploits, tools and scripts, and can be accessed from anywhere with an Internet connection. If you are interested to learn more about our CyberQ solution, please contact your training center or visit https://www.cyberq.io/.

Lab Analysis

Analyze and document the results related to this lab exercise. Give an opinion on your target's security posture.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Lab 1

Perform Host Discovery

Host discovery is the process of identifying active hosts in the target network.

Lab Scenario

As a professional ethical hacker or pen tester, you should be able to scan and detect the active network systems/devices in the target network. During the network scanning phase of security assessment, your first task is to scan the network systems/devices connected to the target network within a specified IP range and check for live systems in the target network.

Lab Objectives

- Perform host discovery using Nmap
- Perform host discovery using Angry IP Scanner

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2022 virtual machine
- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Ubuntu virtual machine
- Android virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 10 Minutes

Overview of Host Discovery

Host discovery is considered the primary task in the network scanning process. It is used to discover the active/live hosts in a network. It provides an accurate status of the systems in the

network, which, in turn, reduces the time spent on scanning every port on every system in a sea of IP addresses in order to identify whether the target host is up.

The following are examples of host discovery techniques:

- ARP ping scan
- UDP ping scan
- ICMP ping scan (ICMP ECHO ping, ICMP timestamp, ping ICMP, and address mask ping)
- TCP ping scan (TCP SYN ping and TCP ACK ping)
- IP protocol ping scan

Lab Tasks

Task 1: Perform Host Discovery using Nmap

Nmap is a utility used for network discovery, network administration, and security auditing. It is also used to perform tasks such as network inventory, managing service upgrade schedules, and monitoring host or service uptime.

Here, we will use Nmap to discover a list of live hosts in the target network. We can use Nmap to scan the active hosts in the target network using various host discovery techniques such as ARP ping scan, UDP ping scan, ICMP ECHO ping scan, ICMP ECHO ping sweep, etc.

1. Turn on the **Windows 11**, **Windows Server 2022**, **Windows Server 2019**, **Parrot Security**, **Ubuntu**, and **Android** virtual machines.
2. In the login page of **Parrot Security** machine, the **attacker** username will be selected by default. Enter password as **toor** in the **Password** field and press **Enter** to log in to the machine.

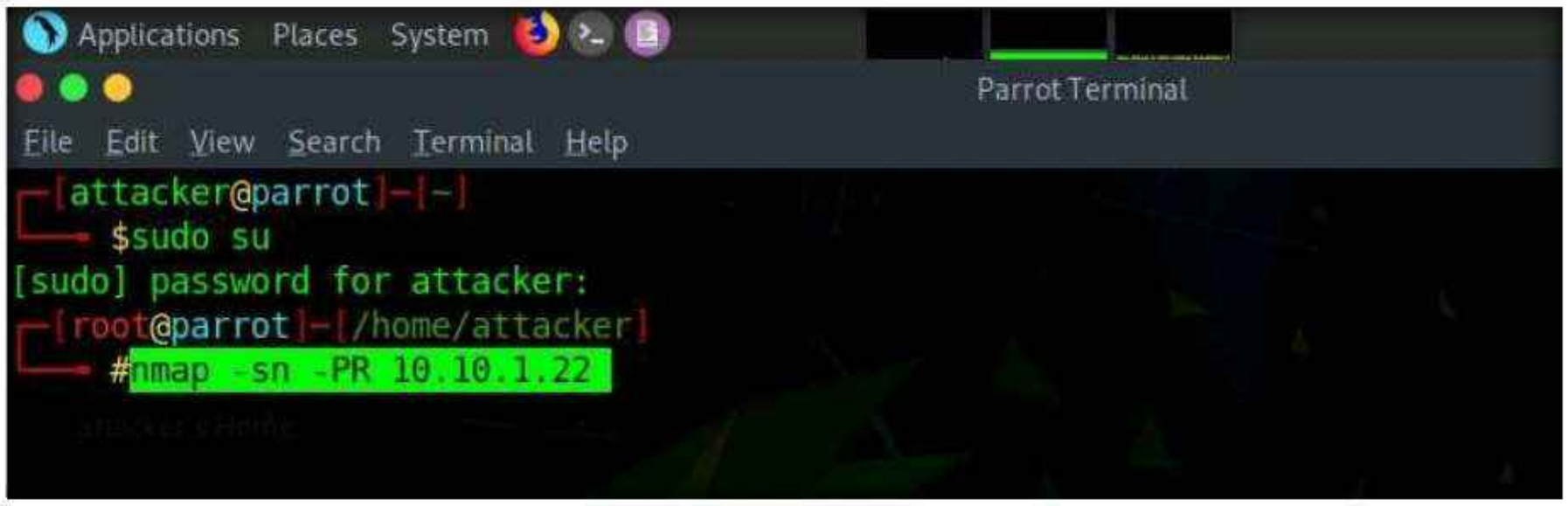
   Note: If a **Parrot Updater** pop-up appears at the top-right corner of **Desktop**, ignore and close it.

   Note: If a **Question** pop-up window appears asking you to update the machine, click **No** to close the window.
3. Click the **MATE Terminal** icon at the top of the **Desktop** to open a **Terminal** window.

4. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
5. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.
6. In the terminal window, type the command **nmap -sn -PR [Target IP Address]** (here, the target IP address is **10.10.1.22**) and press **Enter**.

   Note: **-sn**: disables port scan and **-PR**: performs ARP ping scan.

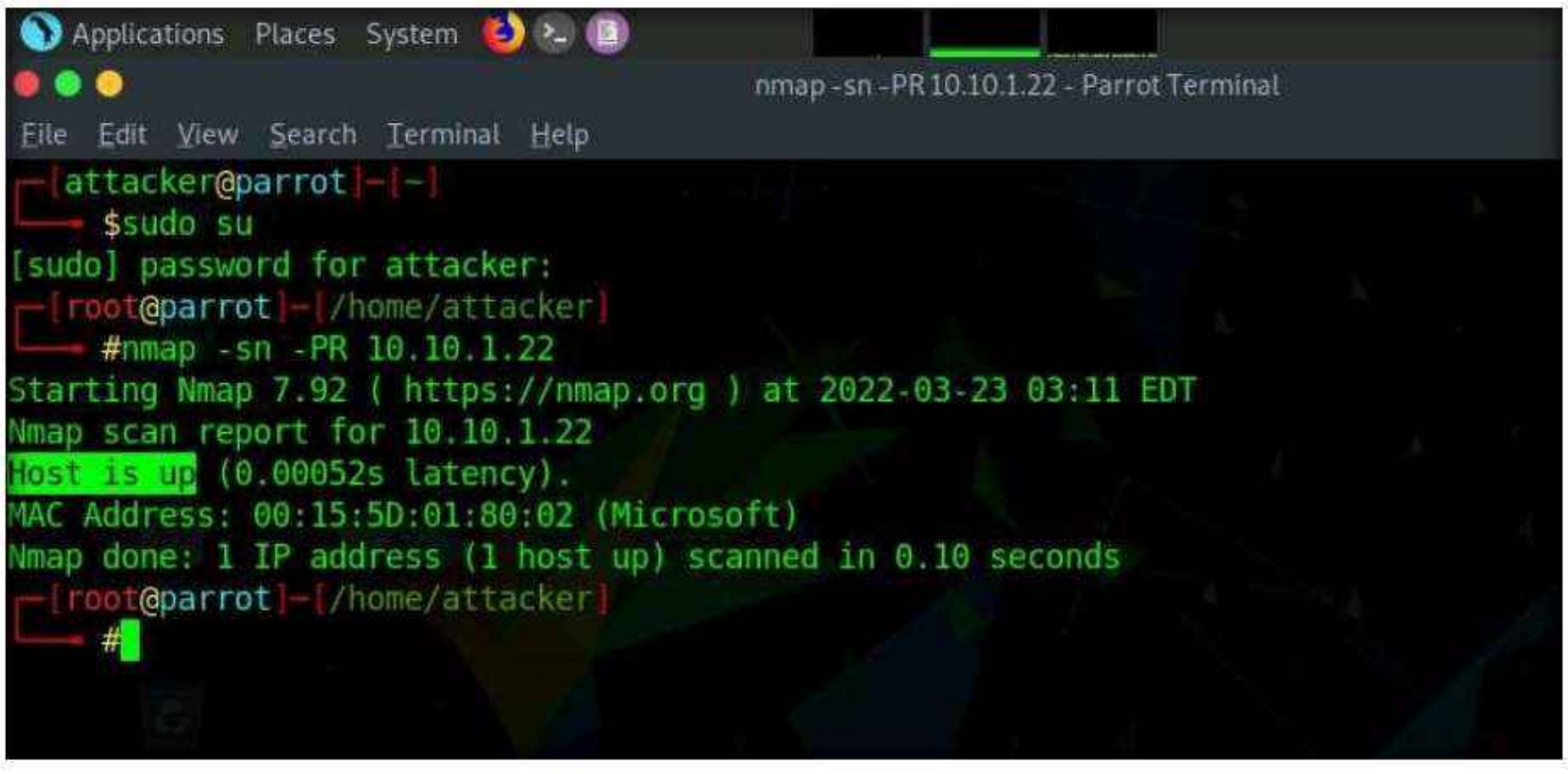


7. The scan results appear, indicating that the target **Host is up**, as shown in the screenshot.

   Note: In this lab, we are targeting the **Windows Server 2022** (**10.10.1.22**) machine.

   Note: The ARP ping scan probes ARP request to target host; an ARP response means that the host is active.

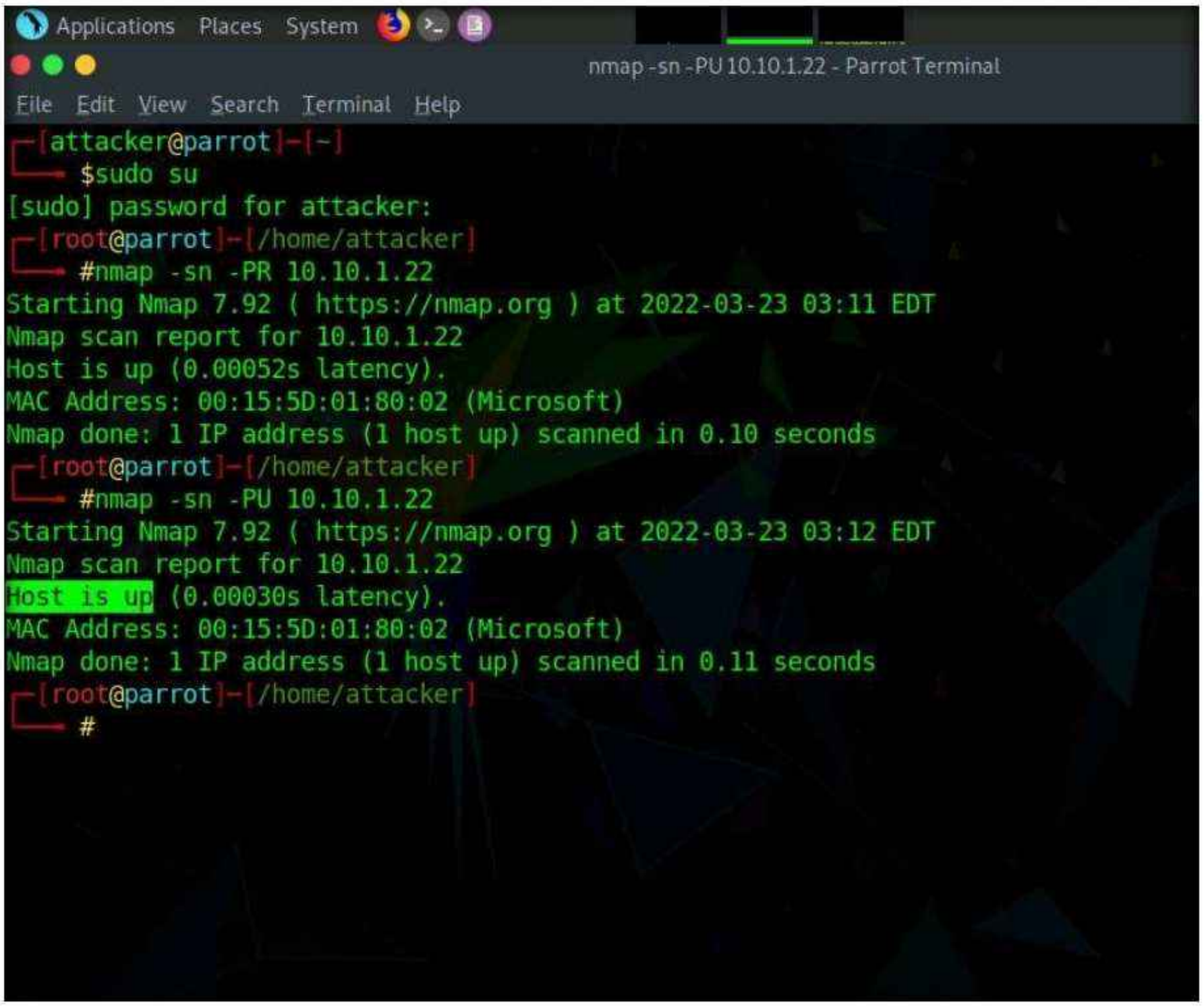
   Note: The MAC address might differ when you perform this task.



8. In the terminal window, type **nmap -sn -PU [Target IP Address]**, (here, the target IP address is **10.10.1.22**) and press **Enter**. The scan results appear, indicating the target **Host is up**, as shown in the screenshot.

   Note: **-PU**: performs the UDP ping scan.

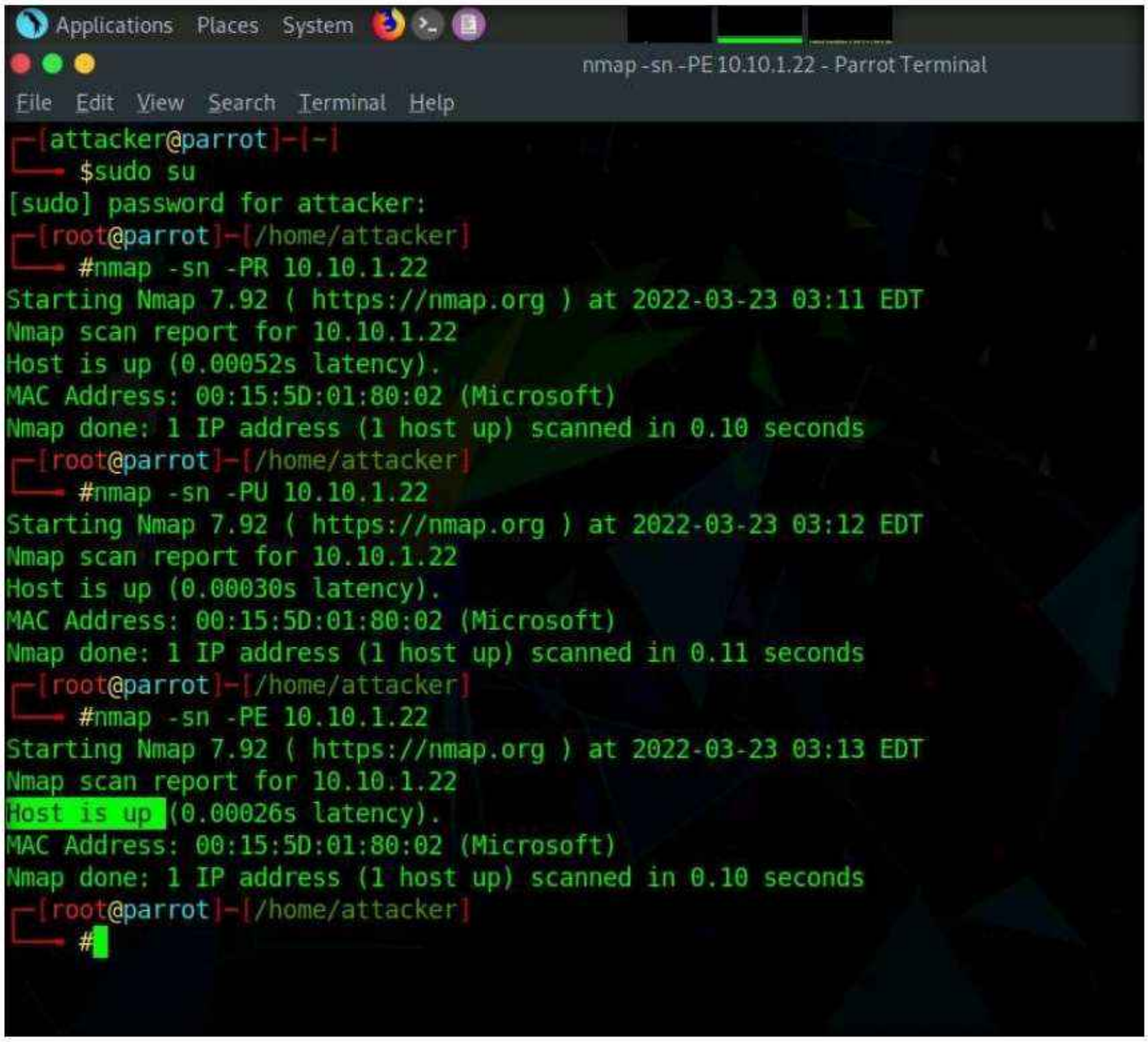
   Note: The UDP ping scan sends UDP packets to the target host; a UDP response means that the host is active. If the target host is offline or unreachable, various error messages such as "host/network unreachable" or "TTL exceeded" could be returned.



9. Now, we will perform the ICMP ECHO ping scan. In the terminal window, type **nmap -sn -PE [Target IP Address]**, (here, the target IP address is **10.10.1.22**) and press **Enter**. The scan results appear, indicating that the target **Host is up**, as shown in the screenshot.

   Note: **-PE**: performs the ICMP ECHO ping scan.

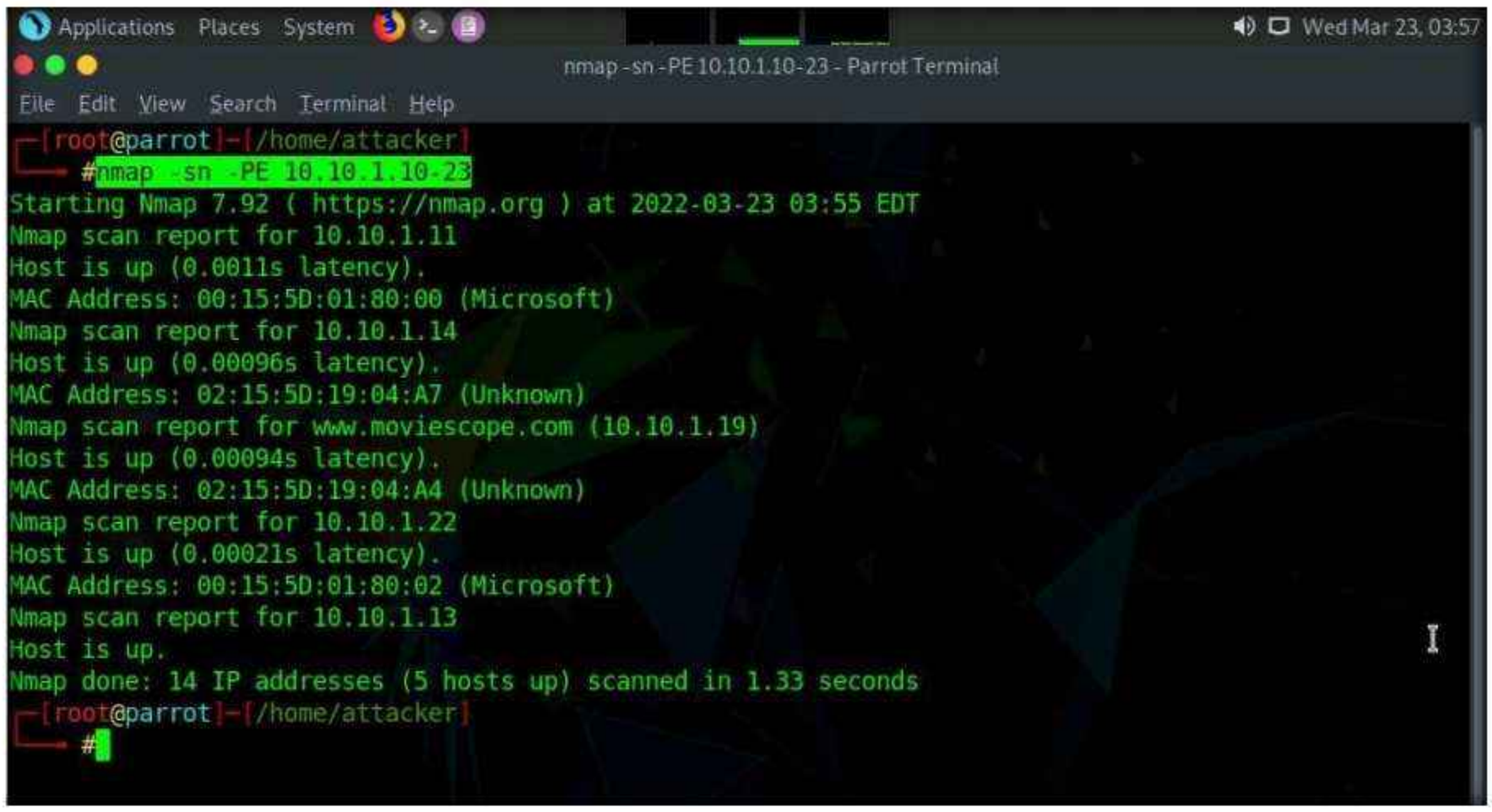
   Note: The ICMP ECHO ping scan involves sending ICMP ECHO requests to a host. If the target host is alive, it will return an ICMP ECHO reply. This scan is useful for locating active devices or determining if the ICMP is passing through a firewall.



10. Now, we will perform an ICMP ECHO ping sweep to discover live hosts from a range of target IP addresses. In the terminal window, type **nmap -sn -PE [Target Range of IP Addresses]** (here, the target range of IP addresses is **10.10.1.10-23**) and press **Enter**. The scan results appear, indicating the target **Host is up**, as shown in the screenshot.

    Note: In this lab task, we are scanning **Windows 11**, **Windows Server 2022**, **Windows Server 2019**, and **Android** machines.

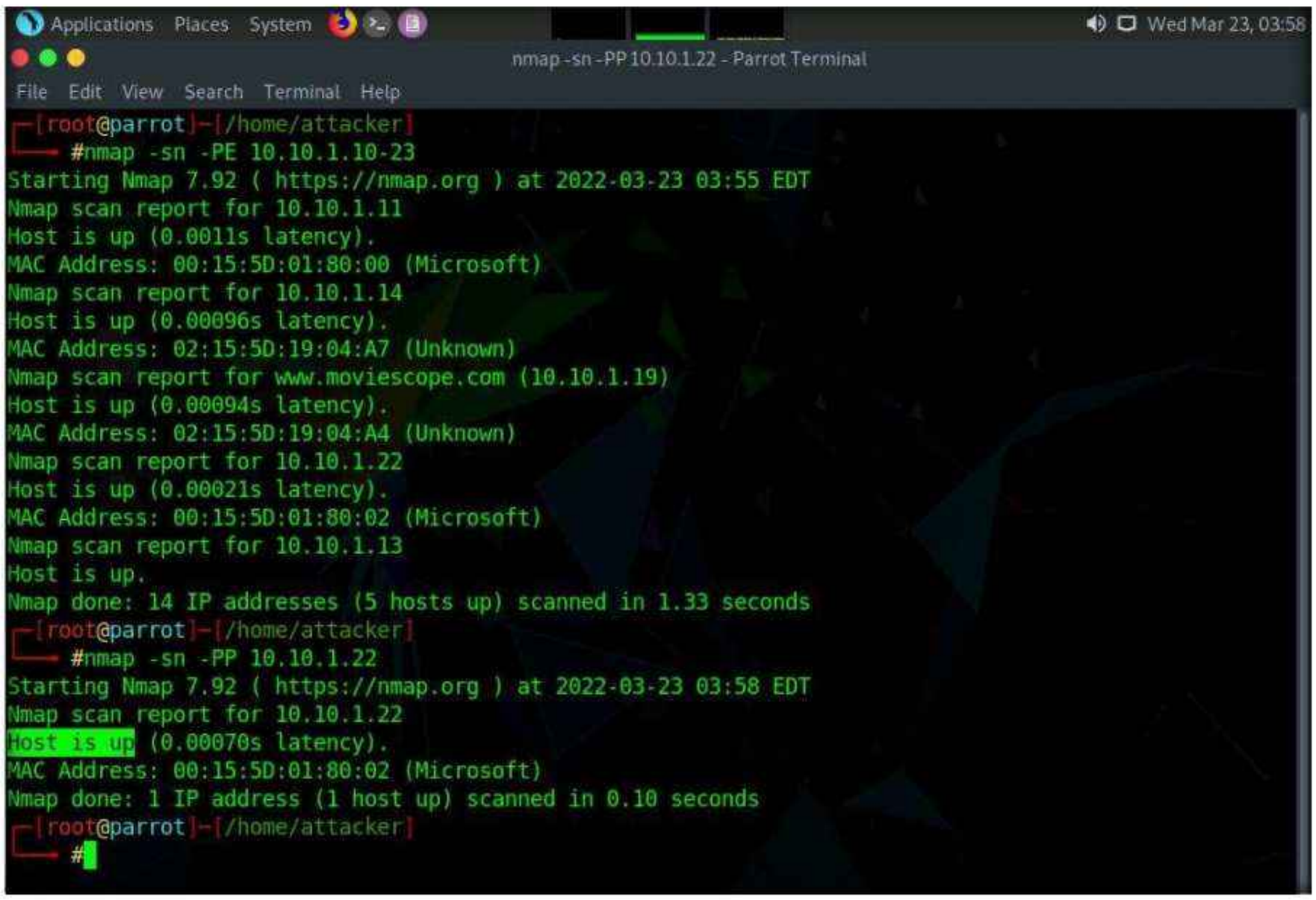
    Note: The ICMP ECHO ping sweep is used to determine the live hosts from a range of IP addresses by sending ICMP ECHO requests to multiple hosts. If a host is alive, it will return an ICMP ECHO reply.



11. In the terminal window, type **nmap -sn -PP [Target IP Address]**, (here, the target IP address is **10.10.1.22**) and press **Enter**. The scan results appear, indicating the target **Host is up**, as shown in the screenshot.

    Note: **-PP**: performs the ICMP timestamp ping scan.

    Note: ICMP timestamp ping is an optional and additional type of ICMP ping whereby the attackers query a timestamp message to acquire the information related to the current time from the target host machine.



12. Apart from the aforementioned network scanning techniques, you can also use the following scanning techniques to perform a host discovery on a target network.
    - **ICMP Address Mask Ping Scan**: This technique is an alternative for the traditional ICMP ECHO ping scan, which are used to determine whether the target host is live specifically when administrators block the ICMP ECHO pings.
    - **# nmap -sn -PM [target IP address]**
    - **TCP SYN Ping Scan**: This technique sends empty TCP SYN packets to the target host, ACK response means that the host is active.
    - **# nmap -sn -PS [target IP address]**
    - **TCP ACK Ping Scan**: This technique sends empty TCP ACK packets to the target host; an RST response means that the host is active.
    - **# nmap -sn -PA [target IP address]**
    - **IP Protocol Ping Scan**: This technique sends different probe packets of different IP protocols to the target host, any response from any probe indicates that a host is active.
    - **# nmap -sn -PO [target IP address]**
13. This concludes the demonstration of discovering the target host(s) in the target network using various host discovery techniques.
14. Close all open windows and document all the acquired information.

Task 2: Perform Host Discovery using Angry IP Scanner

Angry IP Scanner is an open-source and cross-platform network scanner designed to scan IP addresses as well as ports. It simply pings each IP address to check if it is alive; then, optionally by resolving its hostname, determines the MAC address, scans ports, etc. The amount of gathered data about each host can be extended with plugins.

Here, we will use the Angry IP Scanner tool to discover the active hosts in the target network.

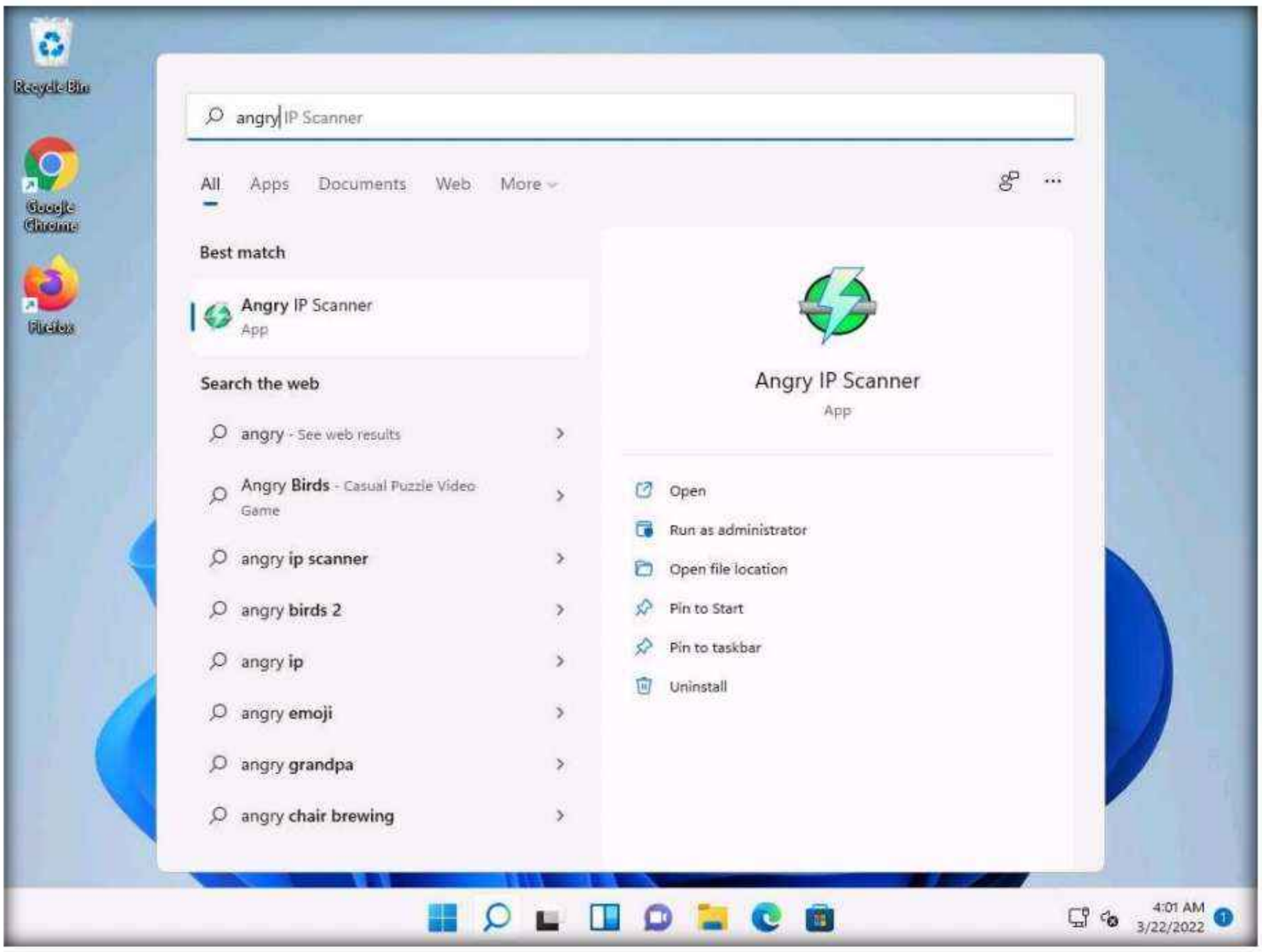
Note: Ensure that all the virtual machines are running.

1. Switch to the **Windows 11** virtual machine. By default, **Admin** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.

   Note: If **Welcome to Windows** wizard appears, click **Continue** and in **Sign in with Microsoft** wizard, click **Cancel**.

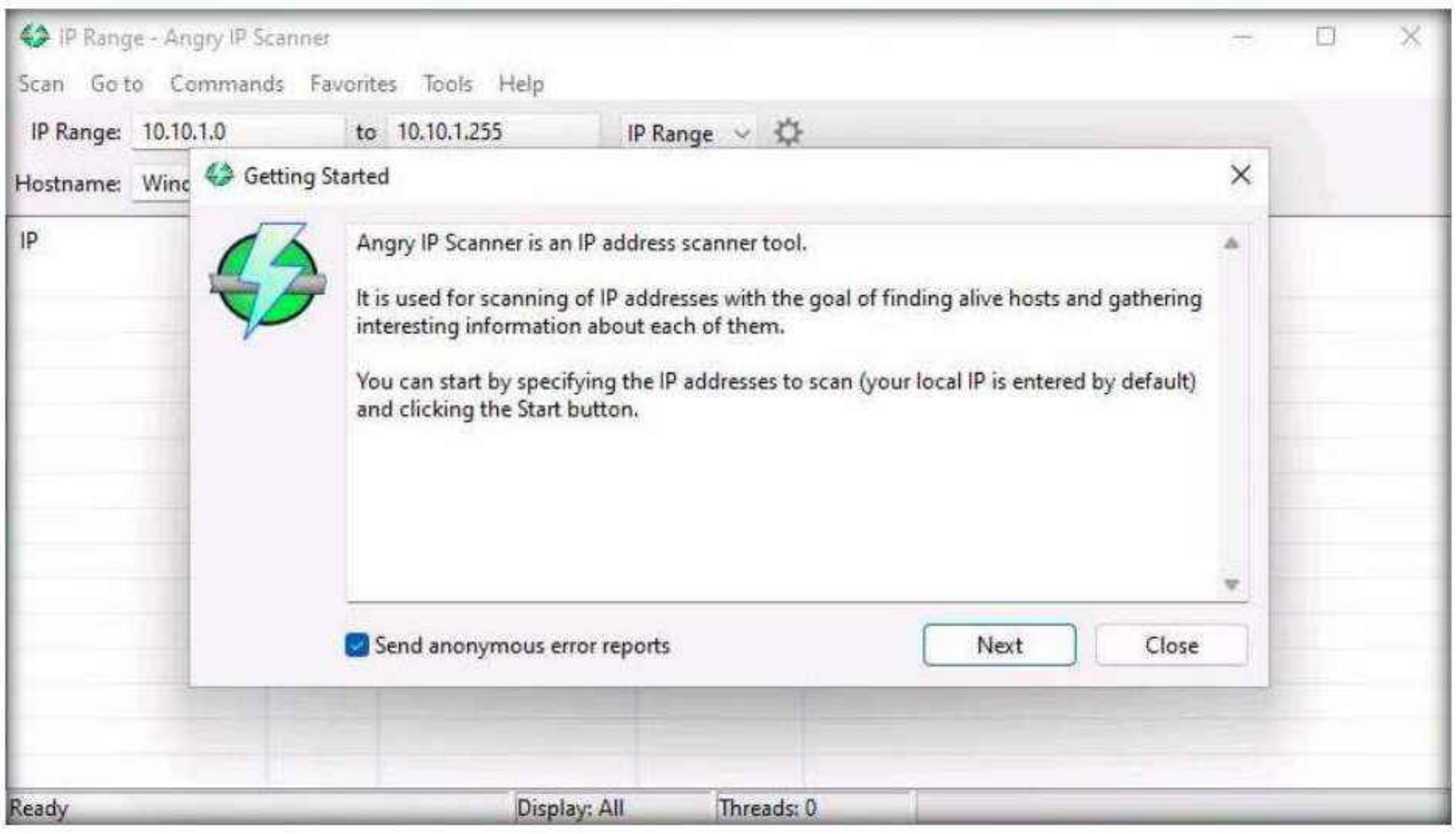
   Note: Networks screen appears, click **Yes** to allow your PC to be discoverable by other PCs and devices on the network.

2. Click **Search** icon () on the **Desktop**. Type **angry** in the search field, the **Angry IP Scanner** appears in the result, click **Open** to launch it.

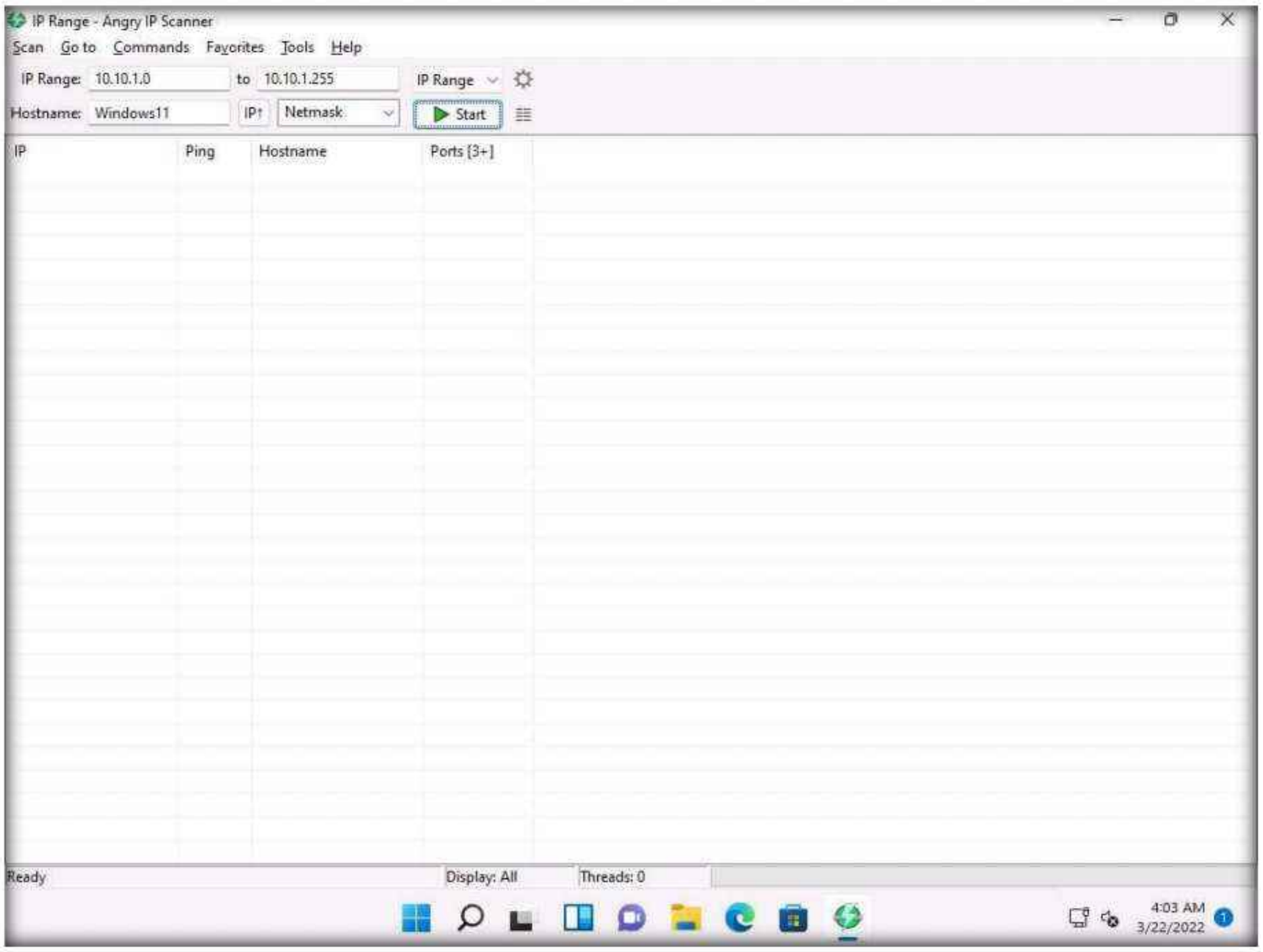


3. **Angry IP Scanner** starts, and a **Getting Started** window pops up. Click **Next**, follow the wizard, and click **Close**.

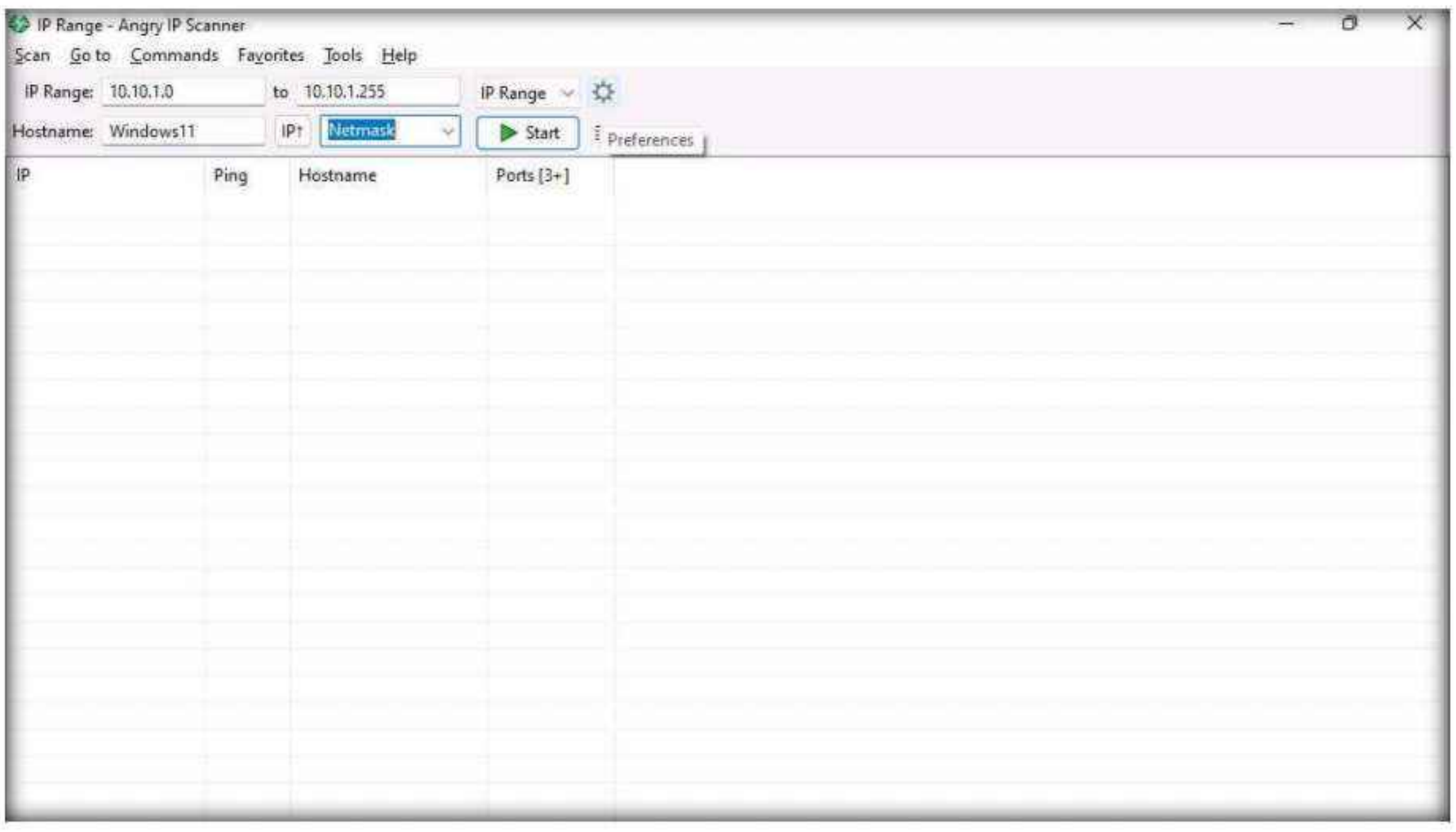
   Note: If **Open File - Security Warning** window appears, click **Run**.



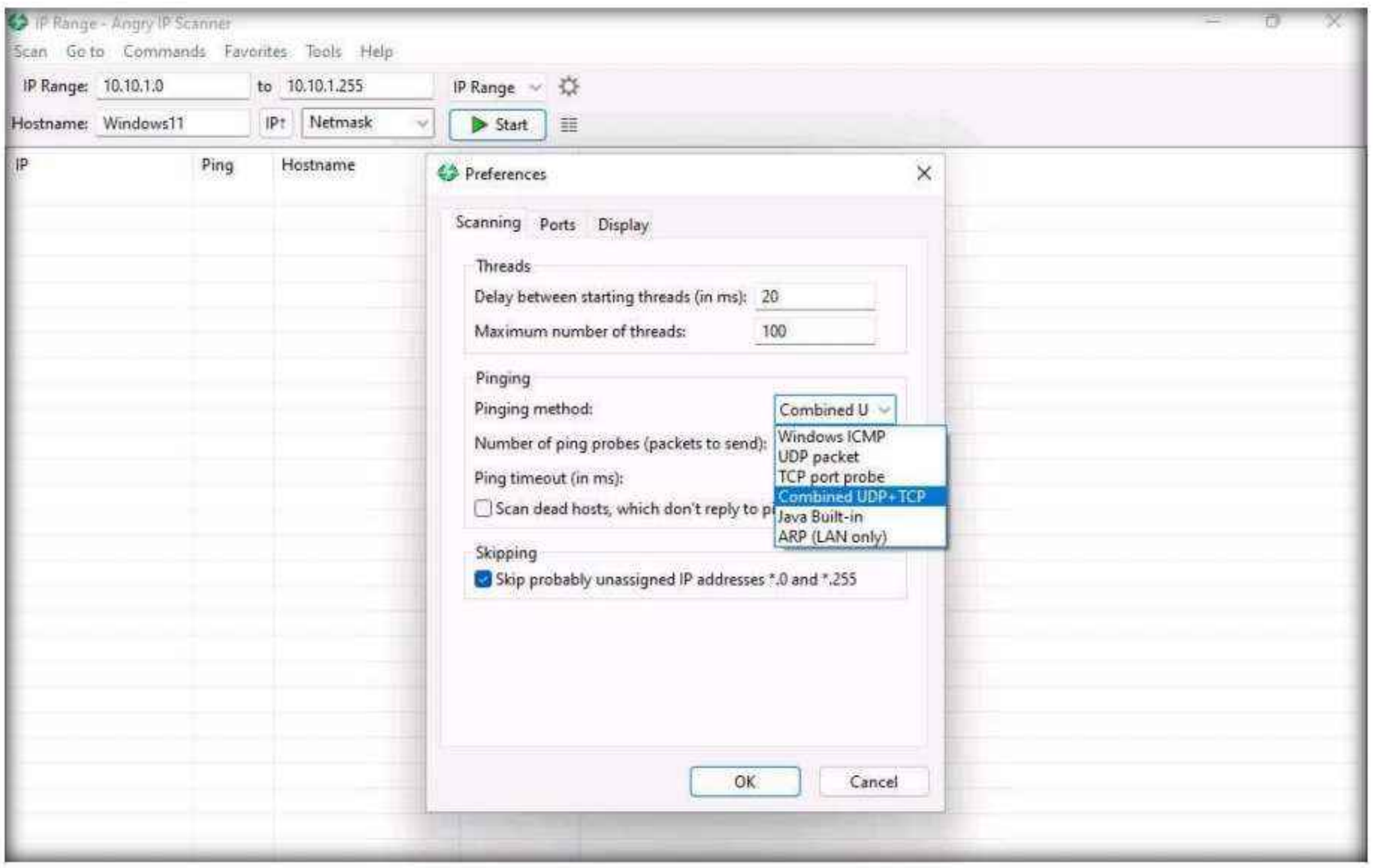
4. The **IP Range - Angry IP Scanner** window appears, as shown in the screenshot.



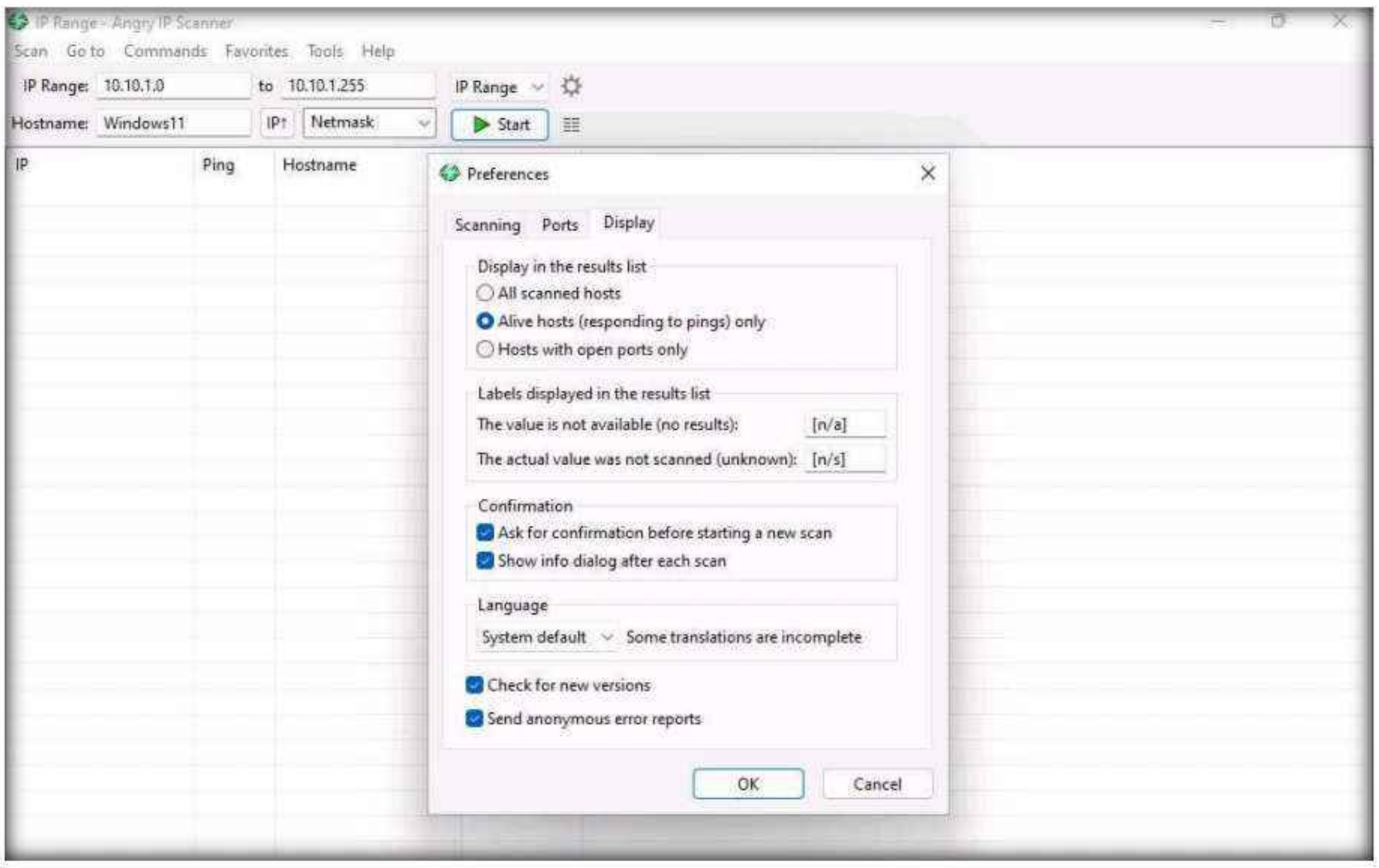
5. In the **IP Range** fields, type the IP range as **10.10.1.0** to **10.10.1.255** and click the **Preferences** icon beside the **IP Range** menu, as shown in the screenshot.



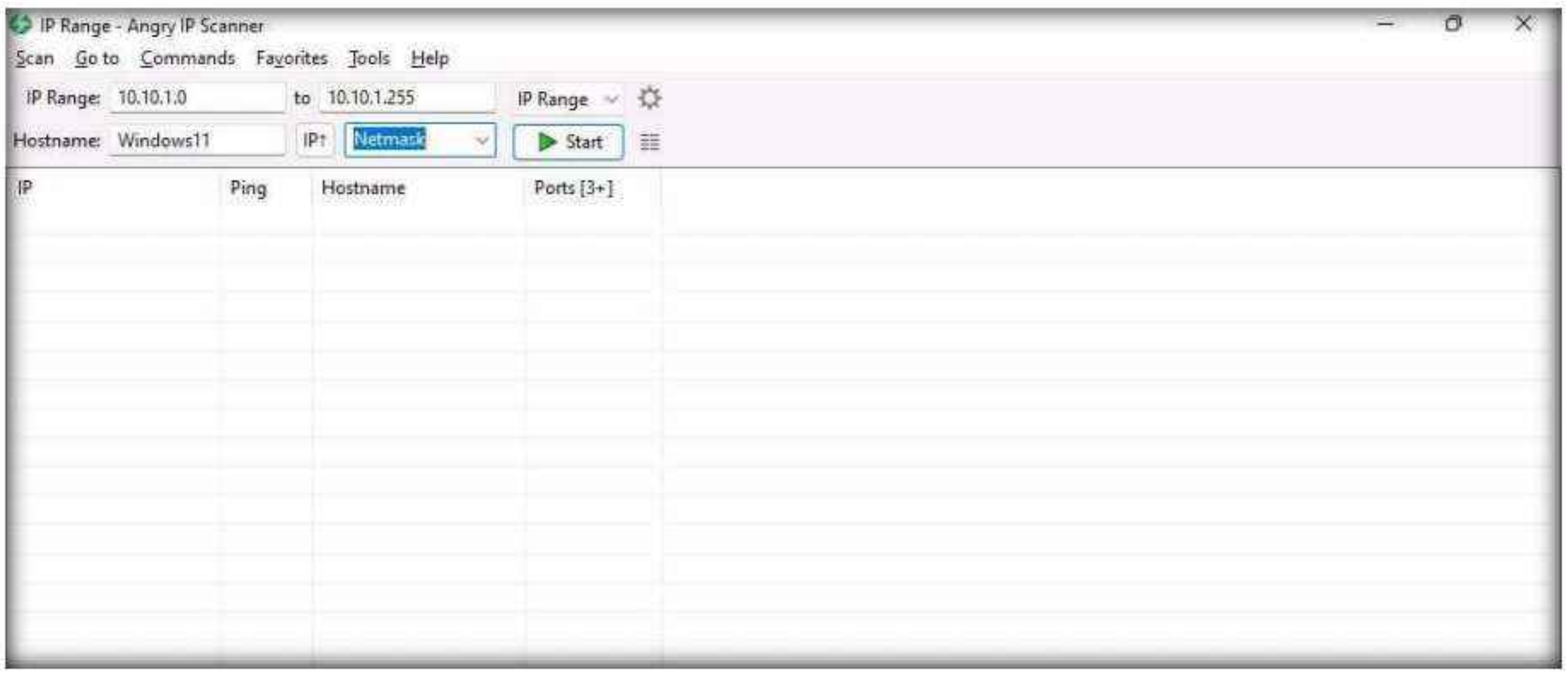
6. The **Preferences** window appears. In the **Scanning** tab, under the **Pinging** section, select the **Pinging method** as **Combined UDP+TCP** from the drop-down list.



7. Now, switch to the **Display** tab. Under the **Display in the results list** section, select the **Alive hosts (responding to pings) only** radio button and click **OK**.

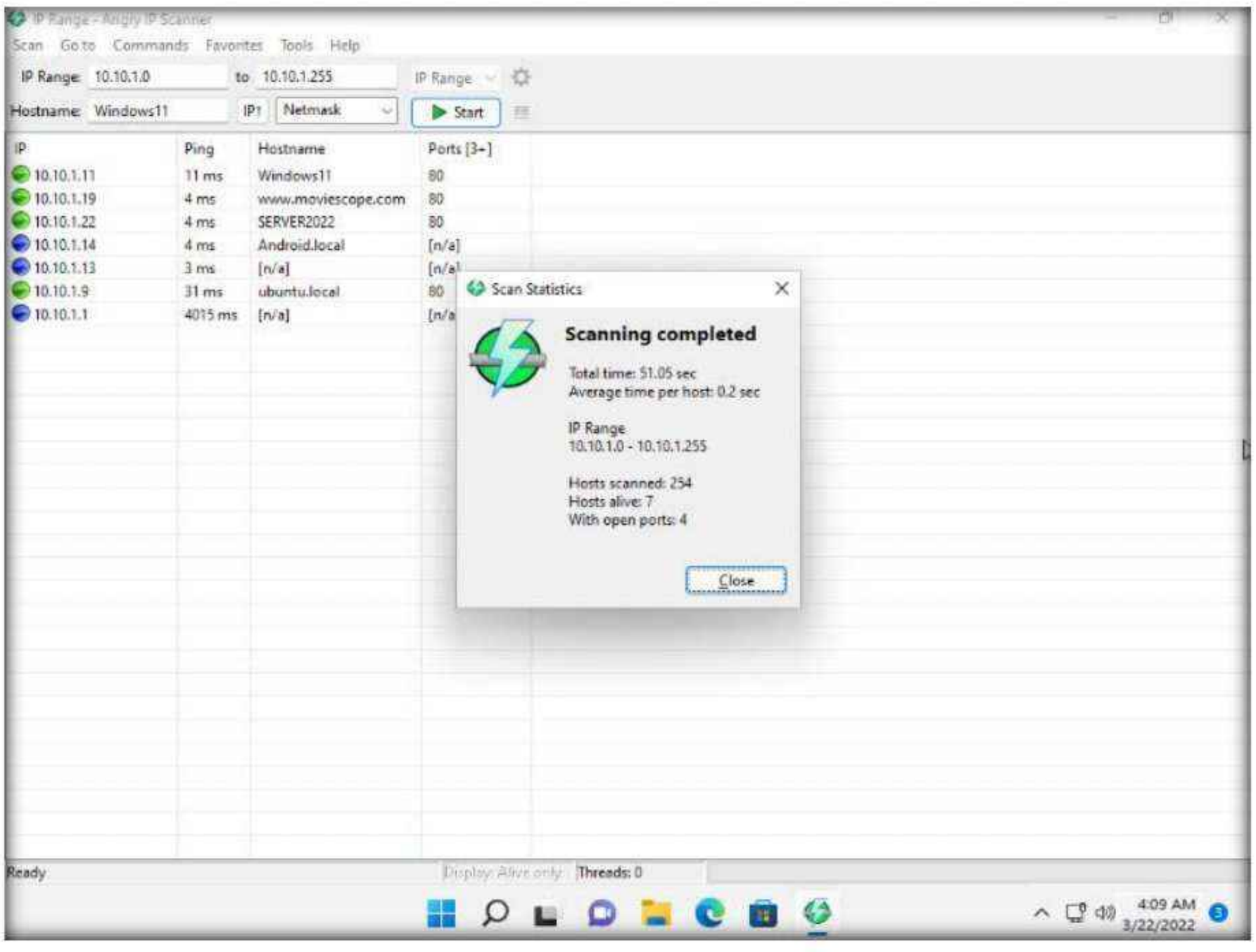


8. In the **IP Range - Angry IP Scanner** window, click the **Start** button to start scanning the IP range that you entered.

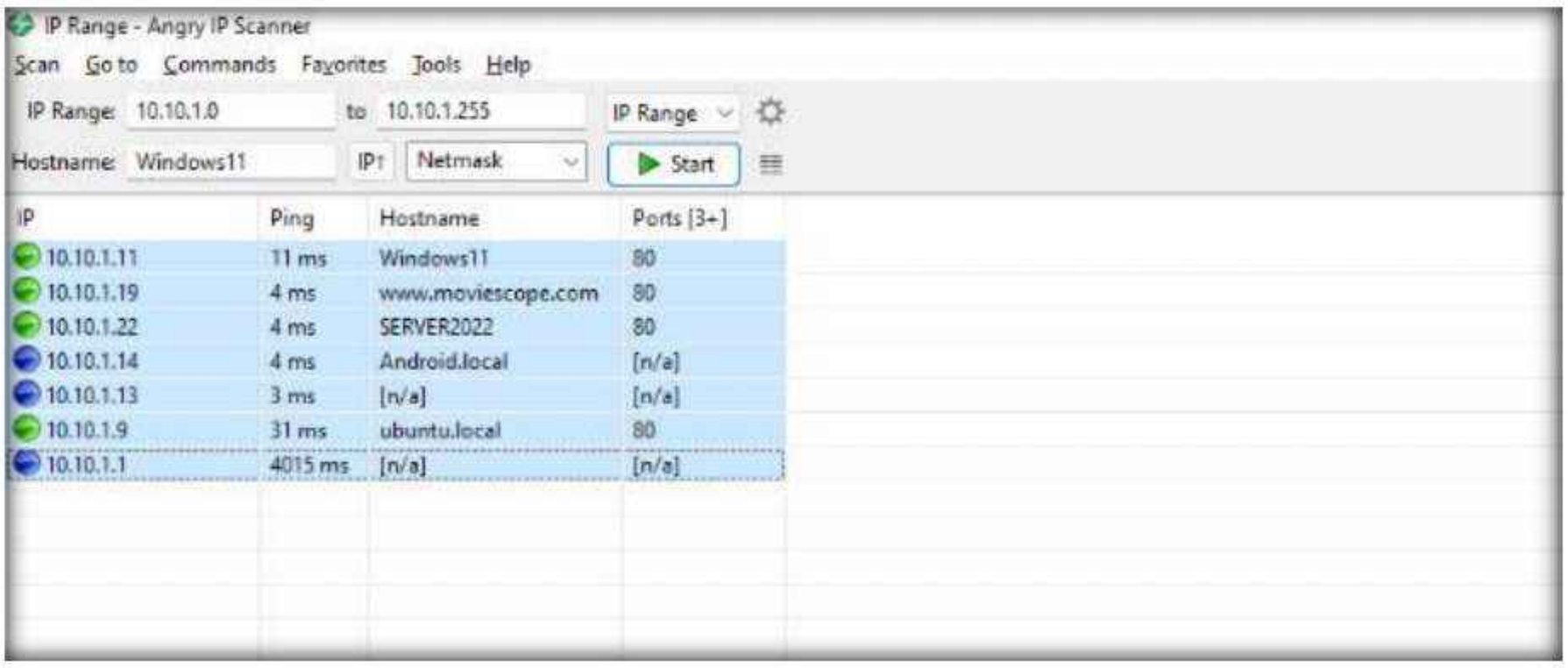


9. **Angry IP Scanner** starts scanning the IP range and begins to list out the alive hosts found along with their hostnames. Check the progress bar on the bottom-right corner to see the progress of the scanning.

10. After the scanning is completed, a **Scan Statistics** pop-up appears. Note the total number of **Hosts alive** (here, 7) and click **Close**.



11. The results of the scan appear in the **IP Range - Angry IP Scanner** window. You can see all active IP addresses with their hostnames listed in the main window.



12. This concludes the demonstration of discovering alive hosts in the target range of IP addresses using Angry IP Scanner.
13. You can also use other ping sweep tools such as **SolarWinds Engineer's Toolset** (https://www.solarwinds.com), **NetScanTools Pro** (https://www.netscantools.com), **Colasoft Ping Tool** (https://www.colasoft.com), **Visual Ping Tester** (http://www.pingtester.net), and **OpUtils** (https://www.manageengine.com) to discover active hosts in the target network.
14. Close all open windows and document all the acquired information.
15. Turn off all the virtual machines (**Windows 11**, **Windows Server 2022**, **Windows Server 2019**, **Parrot Security**, **Ubuntu**, and **Android**).

Lab Analysis

Analyze and document the results of this lab exercise.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Internet Connection Required	
☐ Yes	☑ No
Platform Supported	
☑ Classroom	☑ CyberQ

Lab 2

Perform Port and Service Discovery

Port and service discovery is the process of identifying open ports and services running on the target IP addresses/active hosts.

Lab Scenario

As a professional ethical hacker or a pen tester, the next step after discovering active hosts in the target network is to scan for open ports and services running on the target IP addresses in the target network. This discovery of open ports and services can be performed via various port scanning tools and techniques.

Lab Objectives

- Perform port and service discovery using MegaPing
- Perform port and service discovery using NetScanTools Pro
- Perform port scanning using sx tool
- Explore various network scanning techniques using Nmap
- Explore various network scanning techniques using Hping3

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2022 virtual machine
- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Ubuntu virtual machine
- Android virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 45 Minutes

Overview of Port and Service Discovery

Port scanning techniques are categorized according to the type of protocol used for communication within the network.

- TCP Scanning
  - Open TCP scanning methods (TCP connect/full open scan)
  - Stealth TCP scanning methods (Half-open Scan, Inverse TCP Flag Scan, ACK flag probe scan, third party and spoofed TCP scanning methods)
- UDP Scanning
- SCTP Scanning
  - SCTP INIT Scanning
  - SCTP COOKIE/ECHO Scanning
- SSDP and List Scanning
- IPv6 Scanning

Lab Tasks

Task 1: Perform Port and Service Discovery using MegaPing

MegaPing is a toolkit that provides essential utilities for Information System specialists, system administrators, IT solution providers, and individuals. It is used to detect live hosts and open ports of the system in the network, and can scan your entire network and provide information such as open shared resources, open ports, services/drivers active on the computer, key registry entries, users and groups, trusted domains, printers, etc. You can also perform various network troubleshooting activities with the help of integrated network utilities such as DNS lookup name, DNS list hosts, Finger, host monitor, IP scanner, NetBIOS scanner, ping, port scanner, share scanner, traceroute, and Whois.

Here, we will use the MegaPing tool to scan for open ports and services running on the target range of IP addresses.

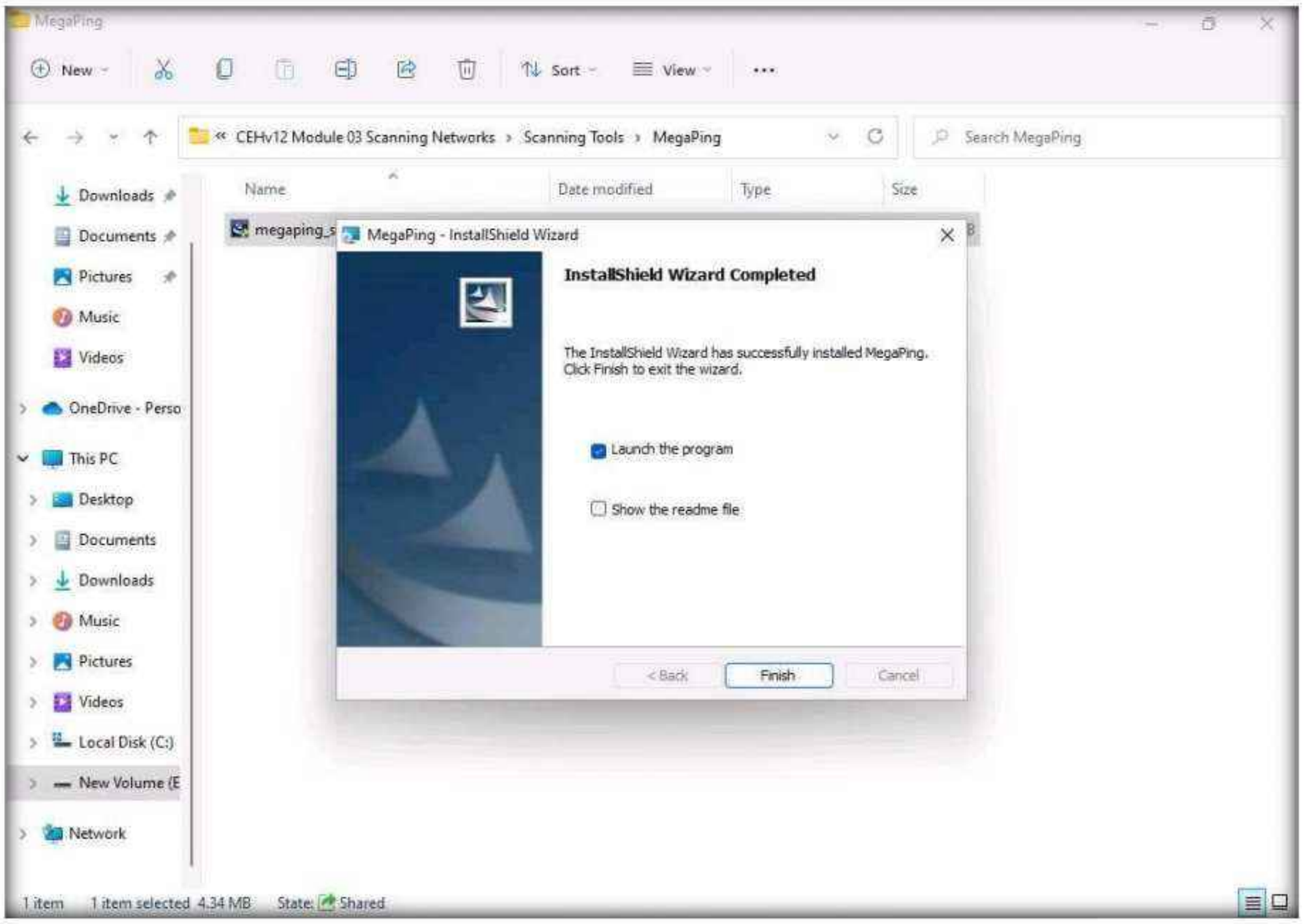
1. Before beginning this task, turn on the **Windows 11**, **Windows Server 2022**, **Windows Server 2019**, **Ubuntu**, **Parrot Security**, and **Android** virtual machines.
2. Switch to the **Windows 11** virtual machine. By default, **Admin** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.

   Note: If **Welcome to Windows** wizard appears, click **Continue** and in **Sign in with Microsoft** wizard, click **Cancel**.

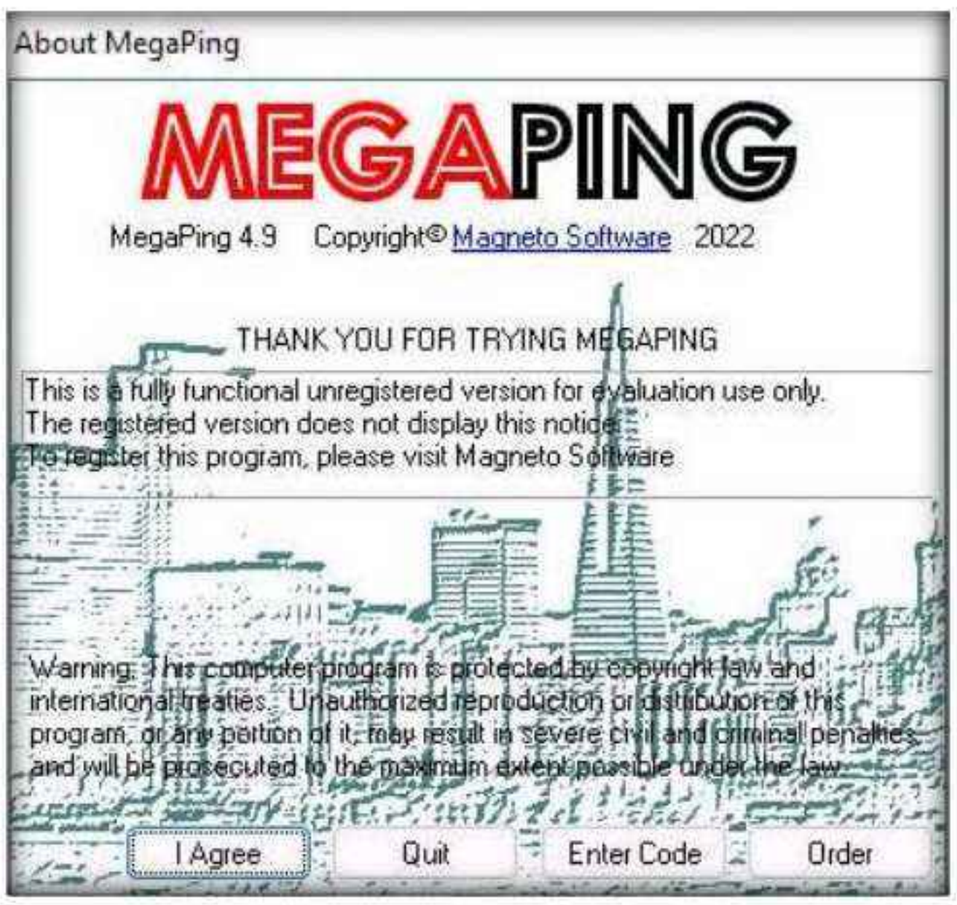
   Note: Networks screen appears, click **Yes** to allow your PC to be discoverable by other PCs and devices on the network.
3. Navigate to **E:\CEH-Tools\CEHv12 Module 03 Scanning Networks\Scanning Tools\MegaPing** and double-click **megaping_setup.exe**.

Note: If a **User Account Control** pop-up appears, click **Yes**.

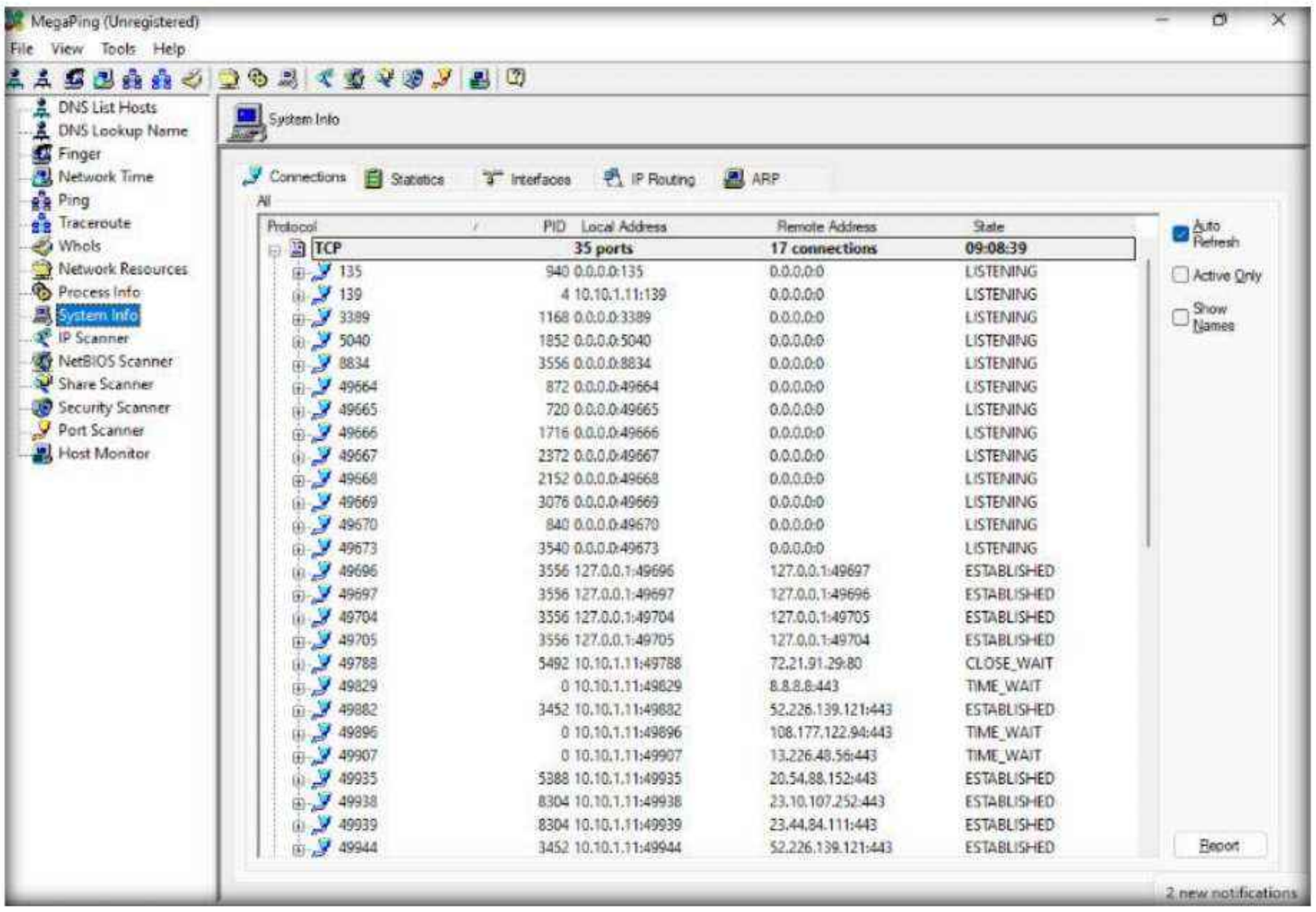
4. The MegaPing **- InstallShield Wizard** window appears; click **Next** and follow the wizard-driven installation steps to install **MegaPing**.
5. After the completion of the installation, click on the **Launch the program** checkbox and click **Finish**.



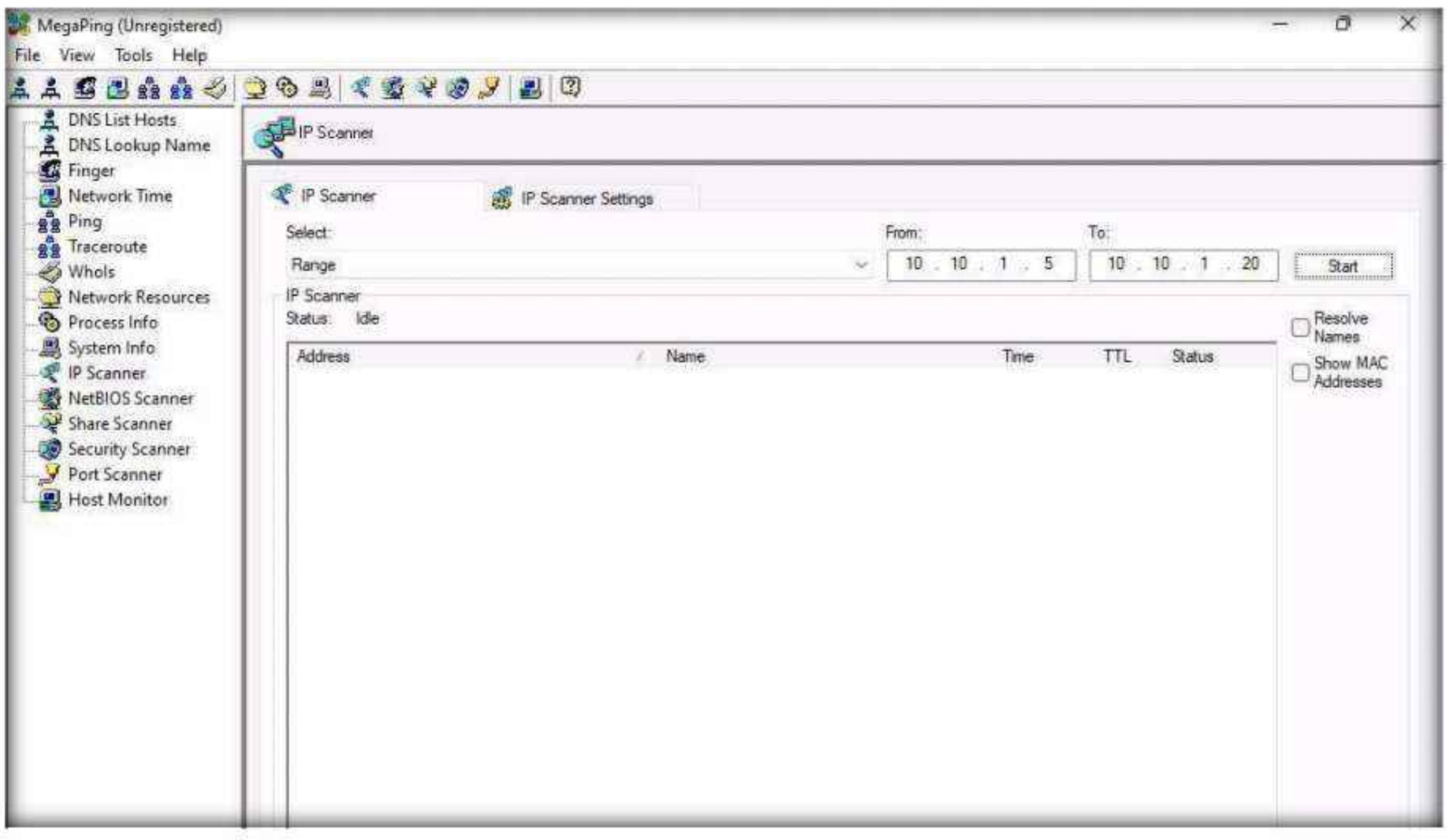
6. The About **MegaPing** window appears; click the **I Agree** button.



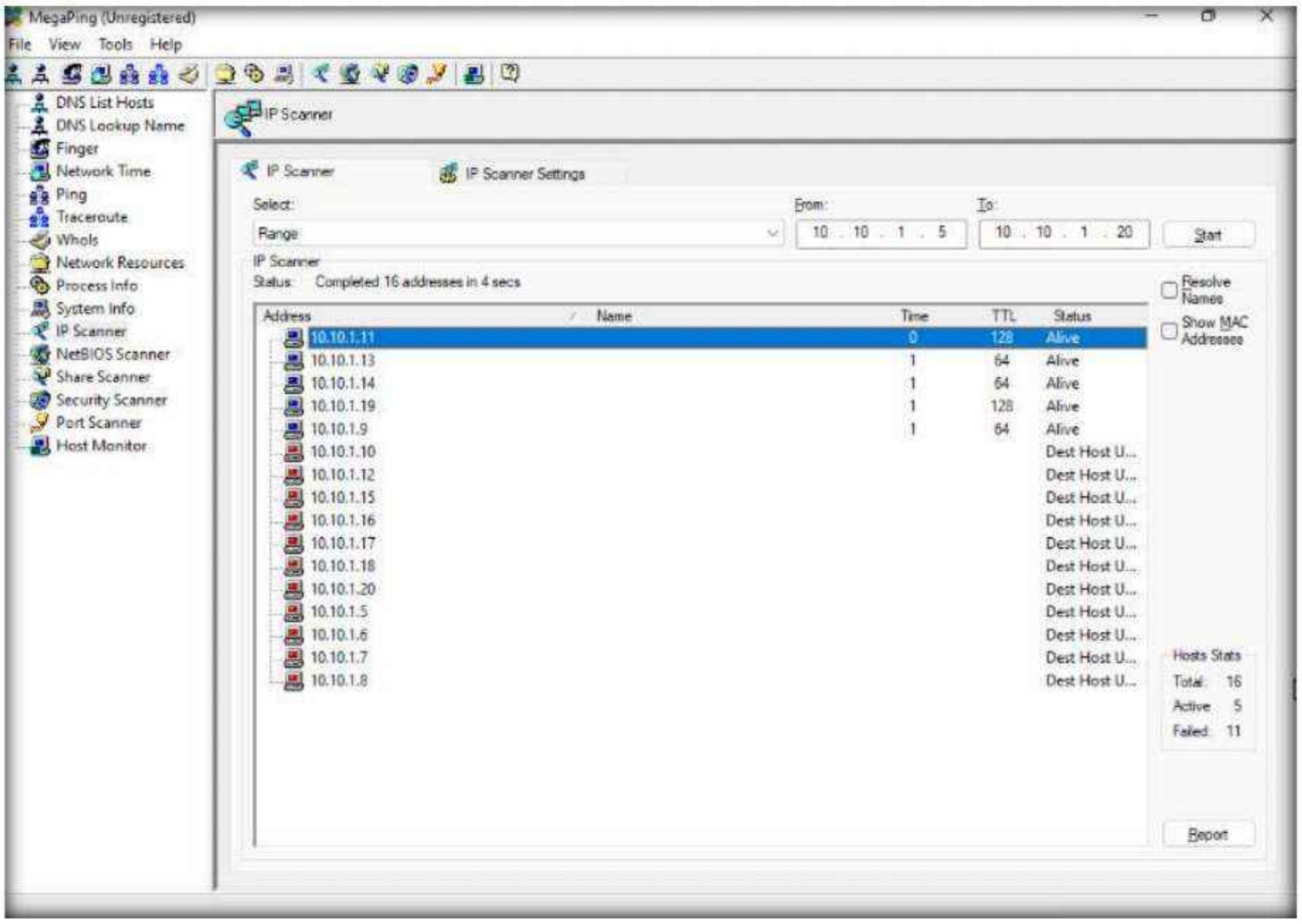
7. The MegaPing **(Unregistered)** GUI appears displaying the **System Info**, as shown in the screenshot.



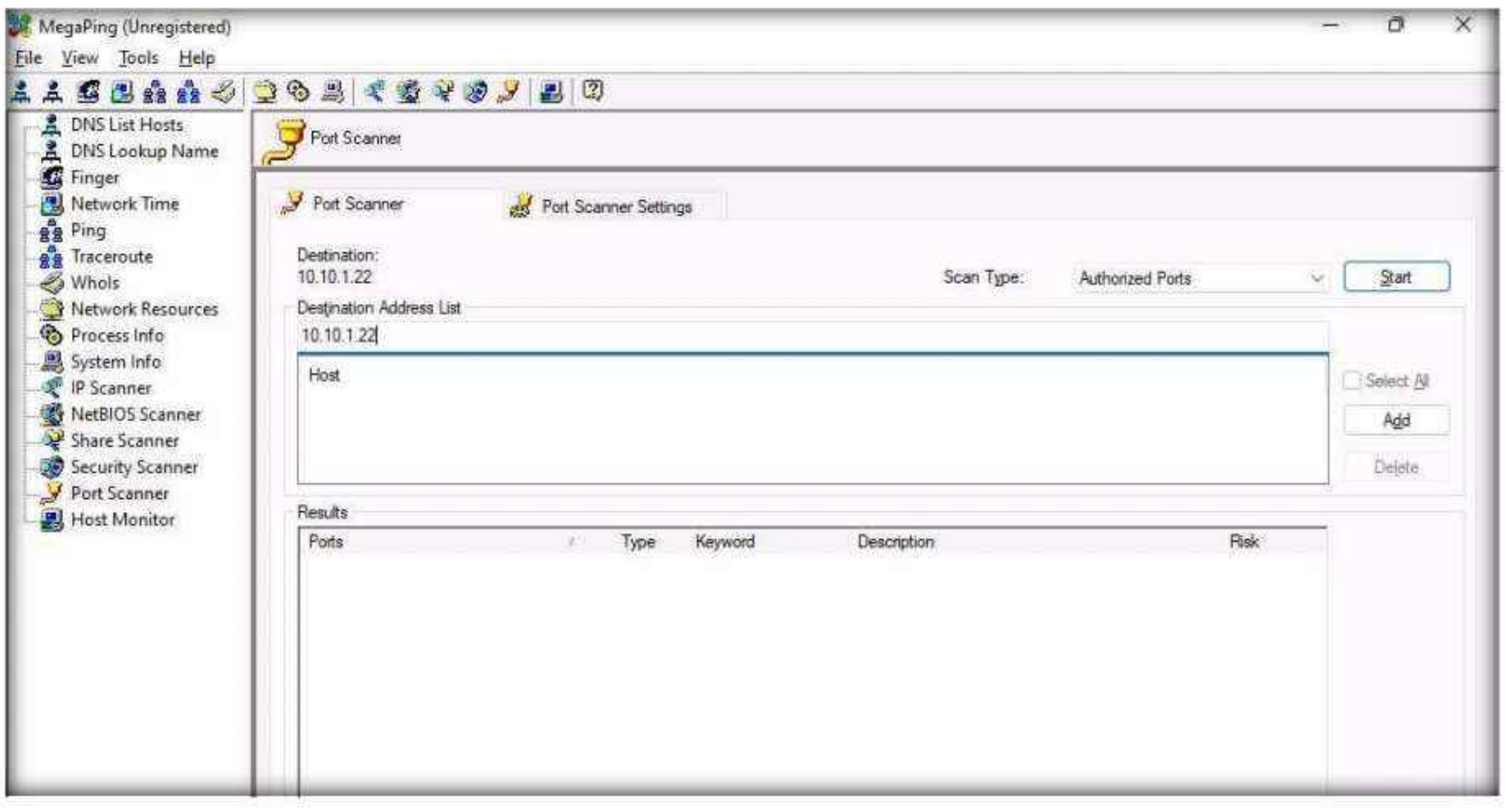
8. Select the **IP Scanner** option from the left pane. In the **IP Scanner** tab in the right-hand pane, enter the IP range in the **From** and **To** fields; in this lab, the IP range is **10.10.1.5** to **10.10.1.20**; then, click **Start**.



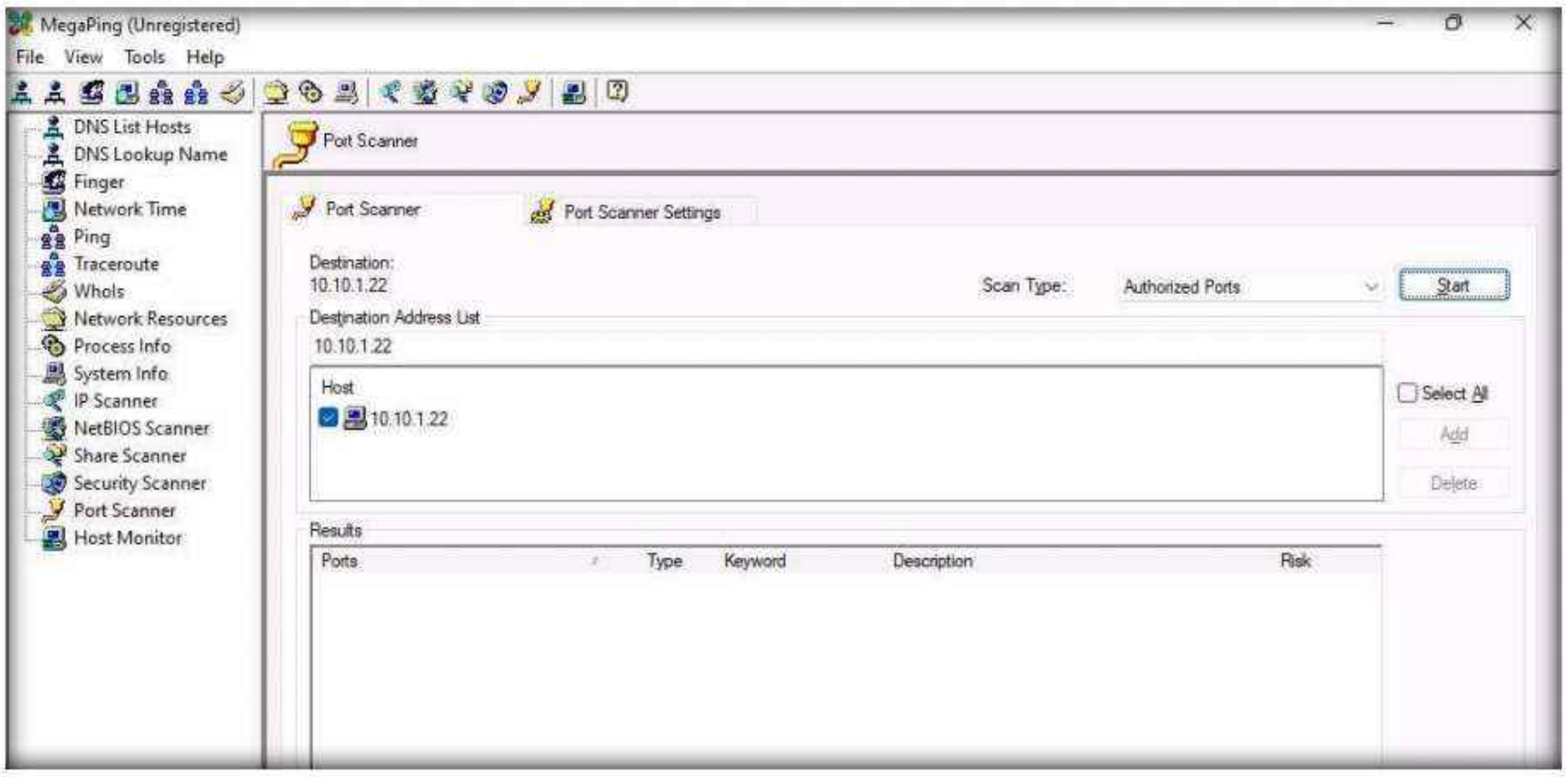
9. MegaPing lists all IP addresses under the specified target range with their TTL value, Status (dead or alive), and statistics of the dead and alive hosts, as shown in the screenshot.



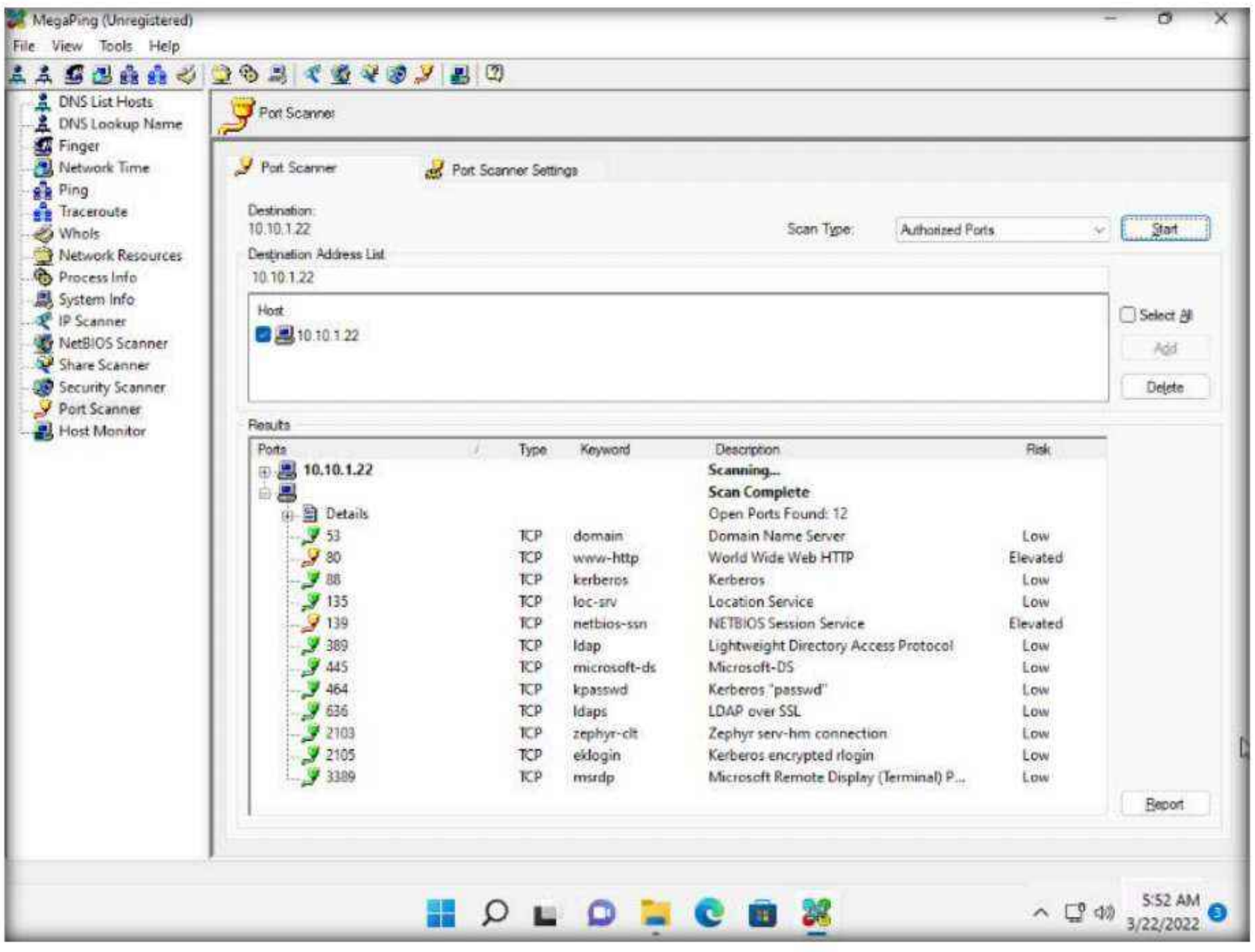
10. Select the **Port Scanner** option from the left-hand pane. In the **Port Scanner** tab in the right-hand pane, enter the IP address of the **Windows Server 2022** (**10.10.1.22**) machine into the **Destination Address List** field and click **Add**.



11. Select the **10.10.1.22** checkbox and click the **Start** button to start listening to the traffic on 10.10.1.22.



12. MegaPing lists the ports associated with **Windows Server 2022** (**10.10.1.22**), with detailed information on port number and type, service running on the port along with the description, and associated risk, as shown in the screenshot. Using this information attackers can penetrate the target network and compromise it, to launch attacks.



13. Similarly, you can perform port and service scanning on other target machines.

14. This concludes the demonstration of discovering open ports and services running on the target IP address using MegaPing.
15. Close all open windows and document all the acquired information.

Task 2: Perform Port and Service Discovery using NetScanTools Pro

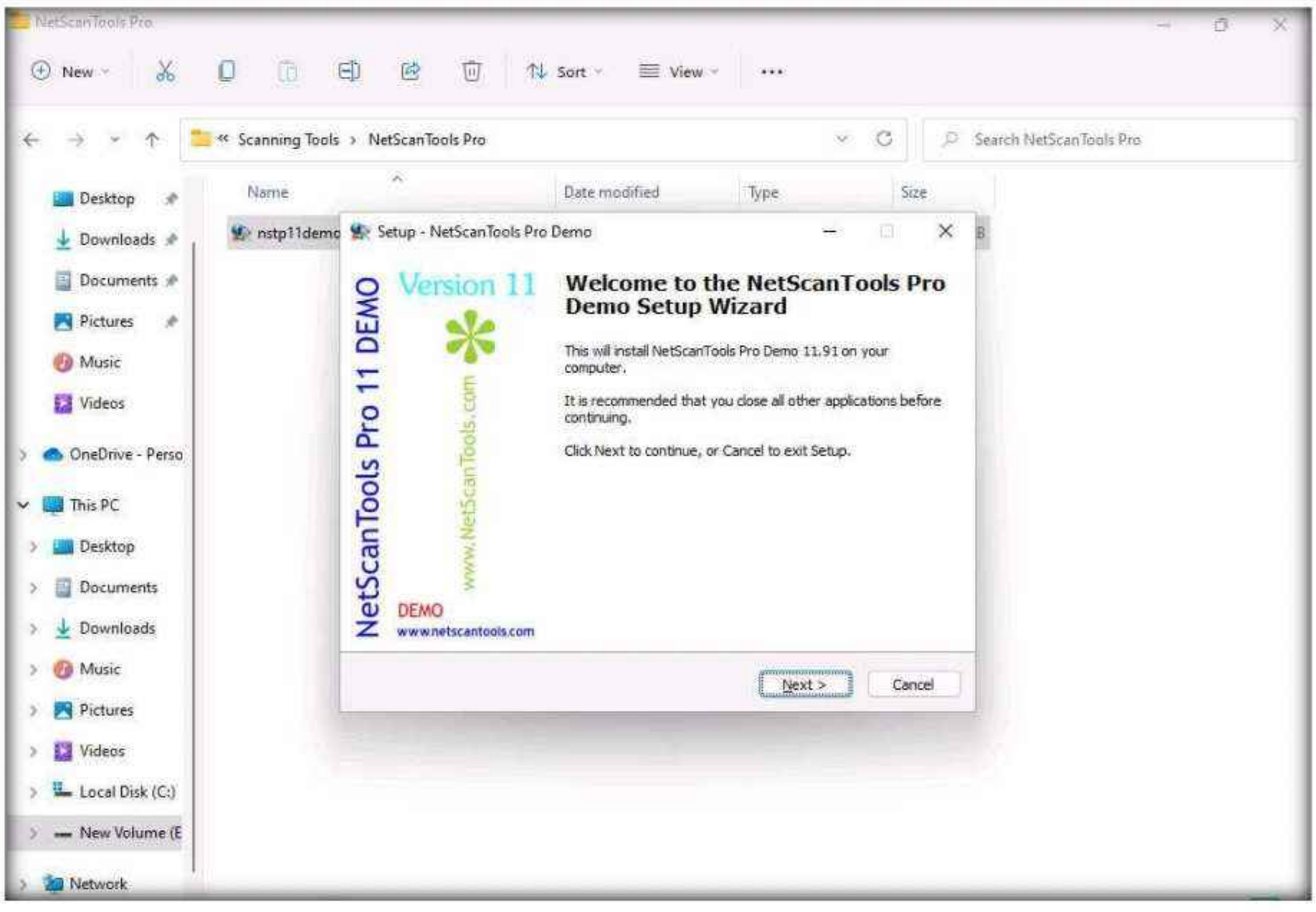
NetScanTools Pro is an integrated collection of utilities that gathers information on the Internet and troubleshoots networks for Network Professionals. With the available tools, you can research IPv4/IPv6 addresses, hostnames, domain names, e-mail addresses, and URLs on the target network.

Here, we will use the NetScanTools Pro tool to discover open ports and services running on the target range of IP addresses.

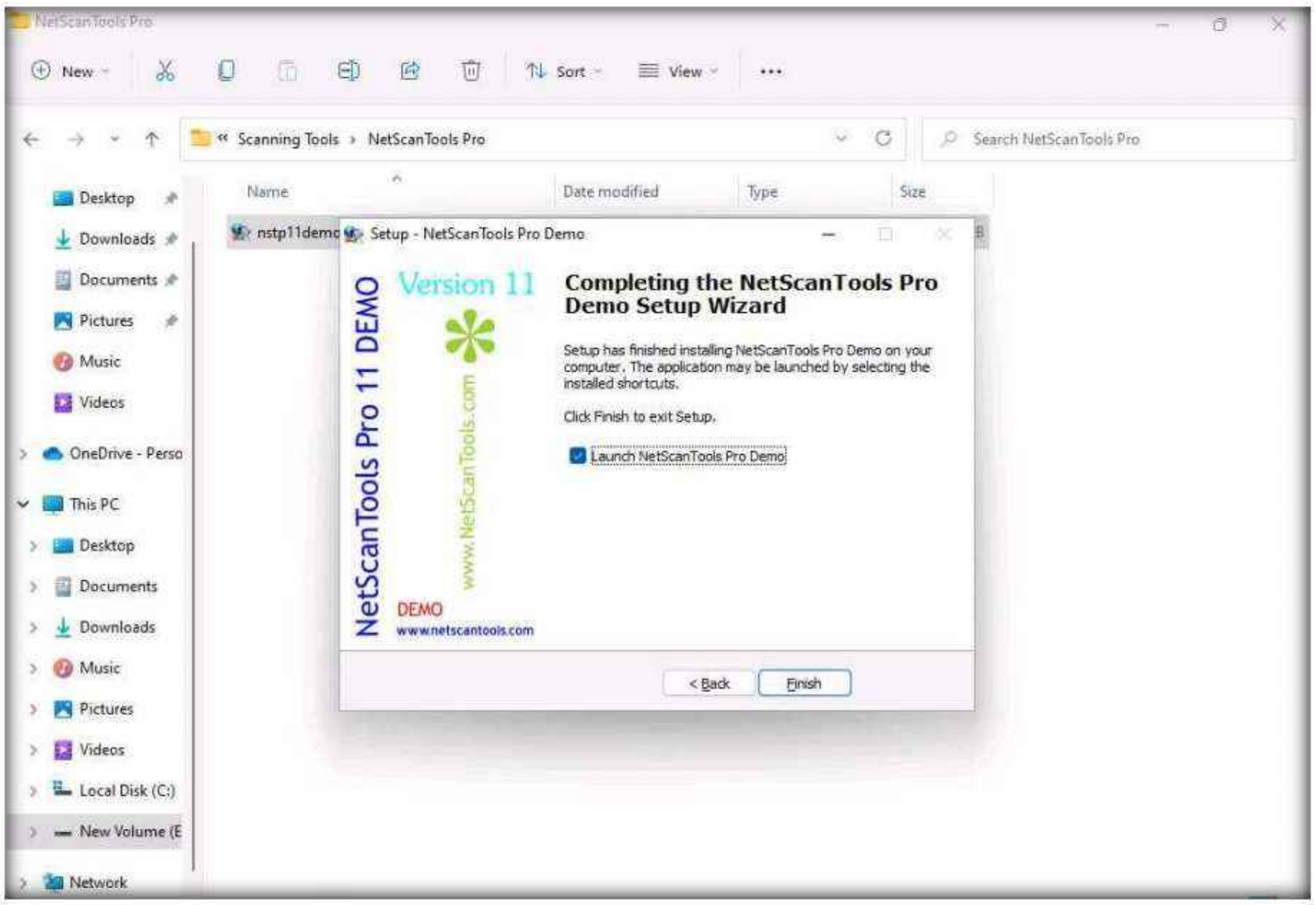
1. Ensure that the virtual machines (**Windows Server 2022**, **Windows Server 2019**, **Ubuntu**, **Parrot Security**, and **Android**) are running.
2. In the **Windows 11** machine, navigate to **E:\CEH-Tools\CEHv12 Module 03 Scanning Networks\Scanning Tools\NetScanTools Pro** and double-click **nstp11demo.exe**.

   Note: If a **User Account Control** pop-up appears, click **Yes**.
3. The **Setup - NetScanTools Pro Demo** window appears, click **Next** and follow the wizard-driven installation steps to install **NetScanTools Pro**.

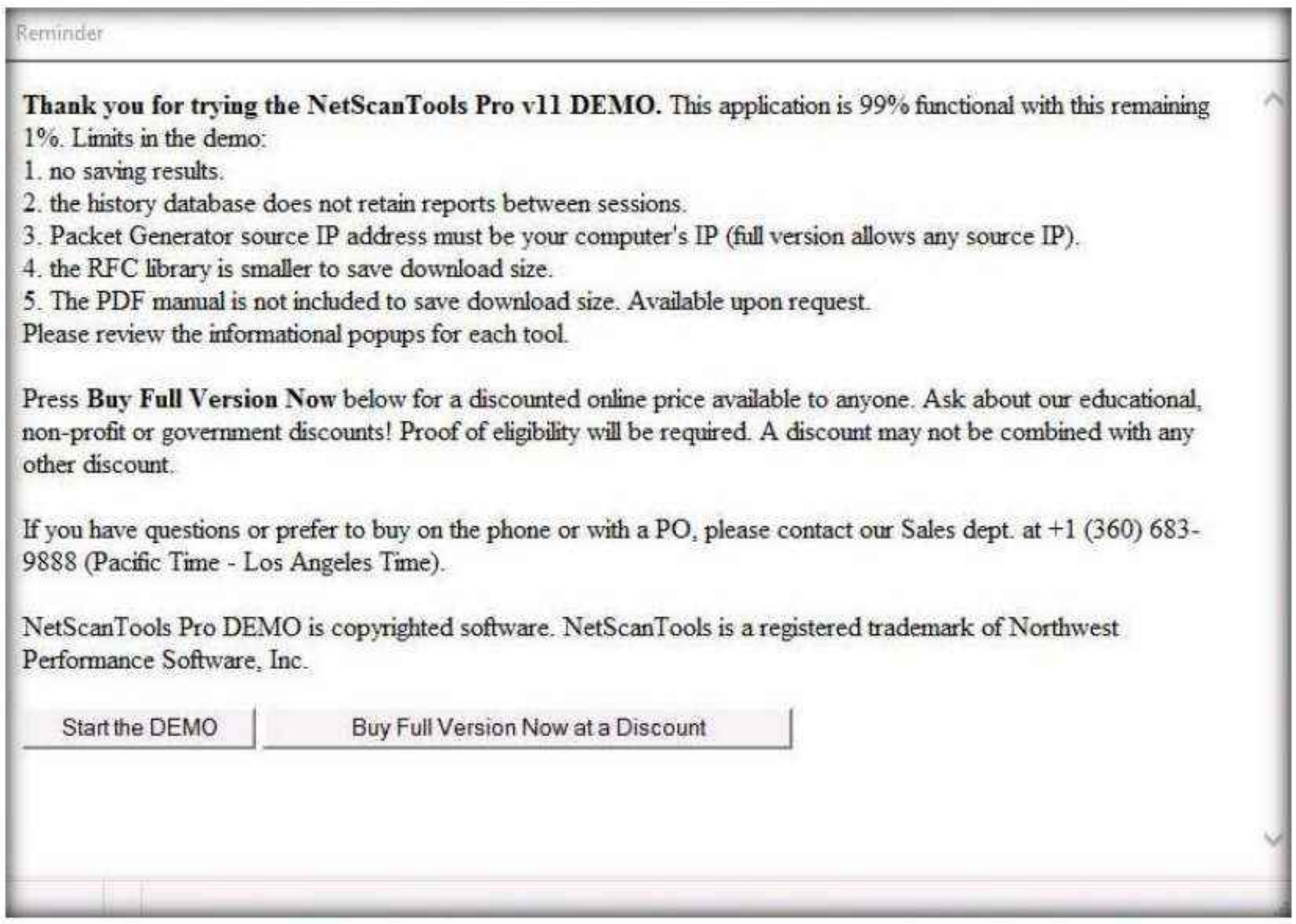
   Note: If a **WinPcap 4.1.3 Setup** pop-up appears, click **Cancel**.



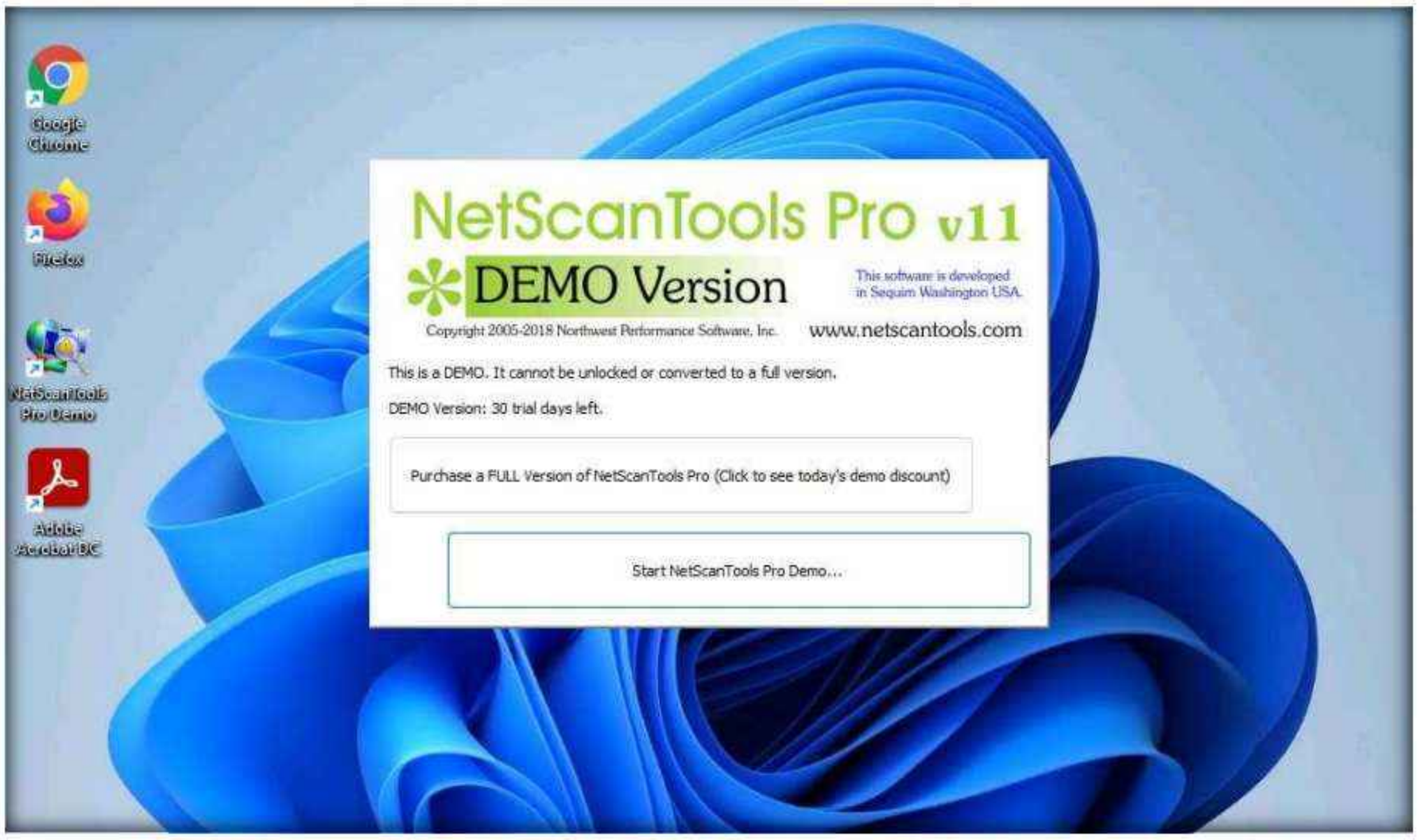
4. In the **Completing the NetScanTools Pro Demo Setup Wizard**, ensure that **Launch NetScanTools Pro Demo** is checked and click **Finish**.



5. The **Reminder** window appears; if you are using a demo version of NetScanTools Pro, click the **Start the DEMO** button.

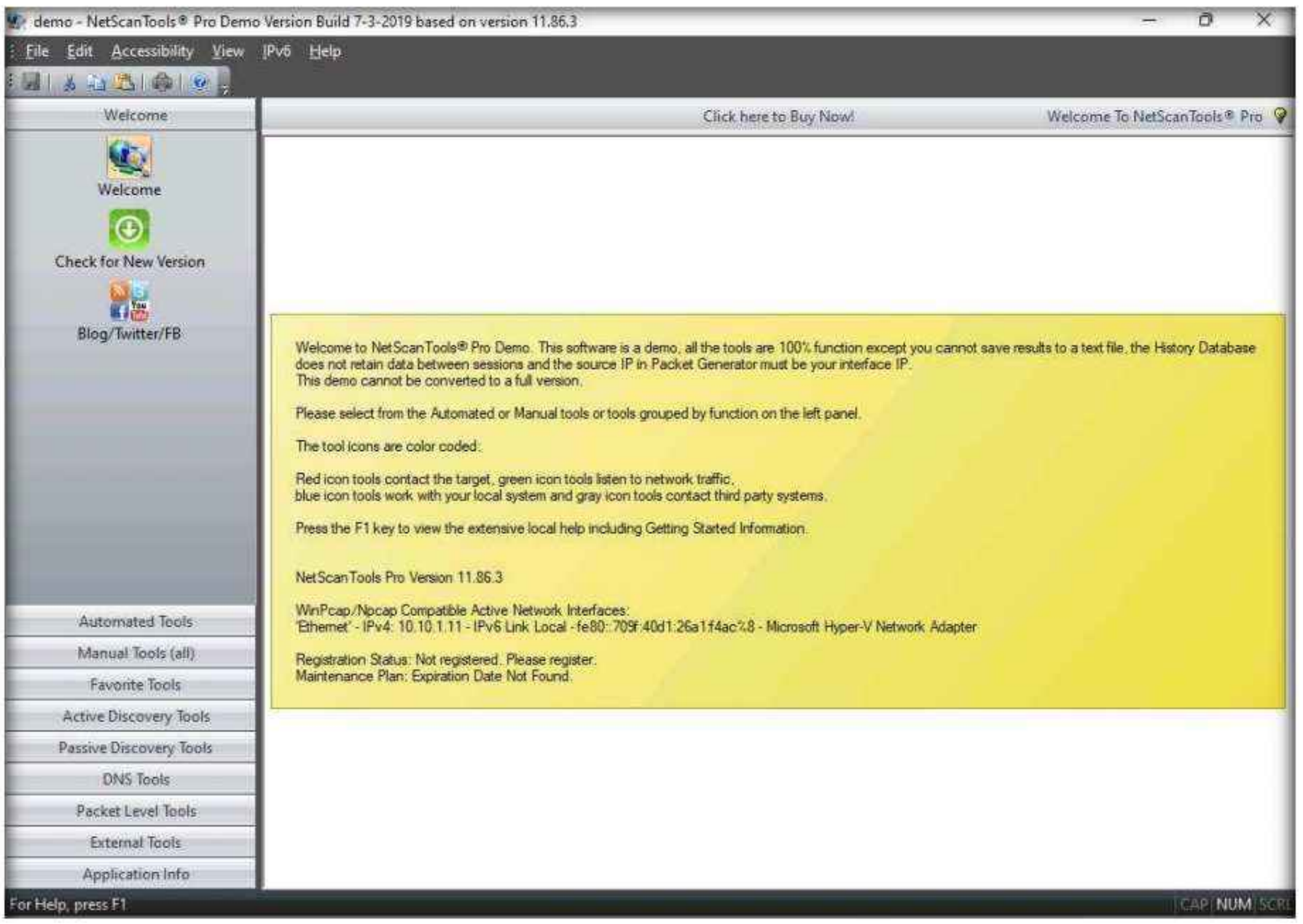


6. A **DEMO Version** pop-up appears; click the **Start NetScanTools Pro Demo…** button.

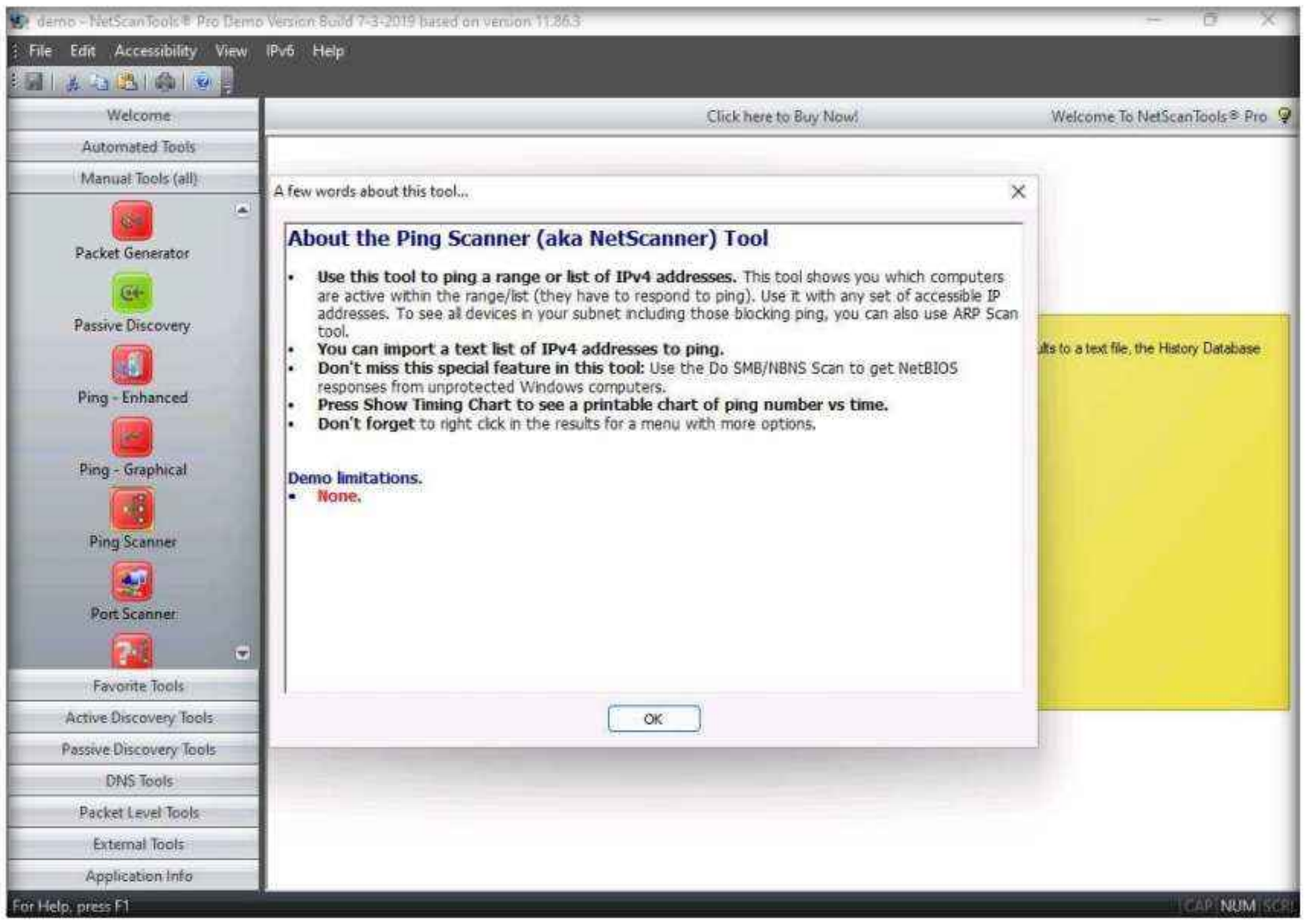


7. The **NetScanTools Pro** main window appears, as shown in the screenshot.

   Note: The version of the **NetScanTools Pro** might differ when you perform the lab.

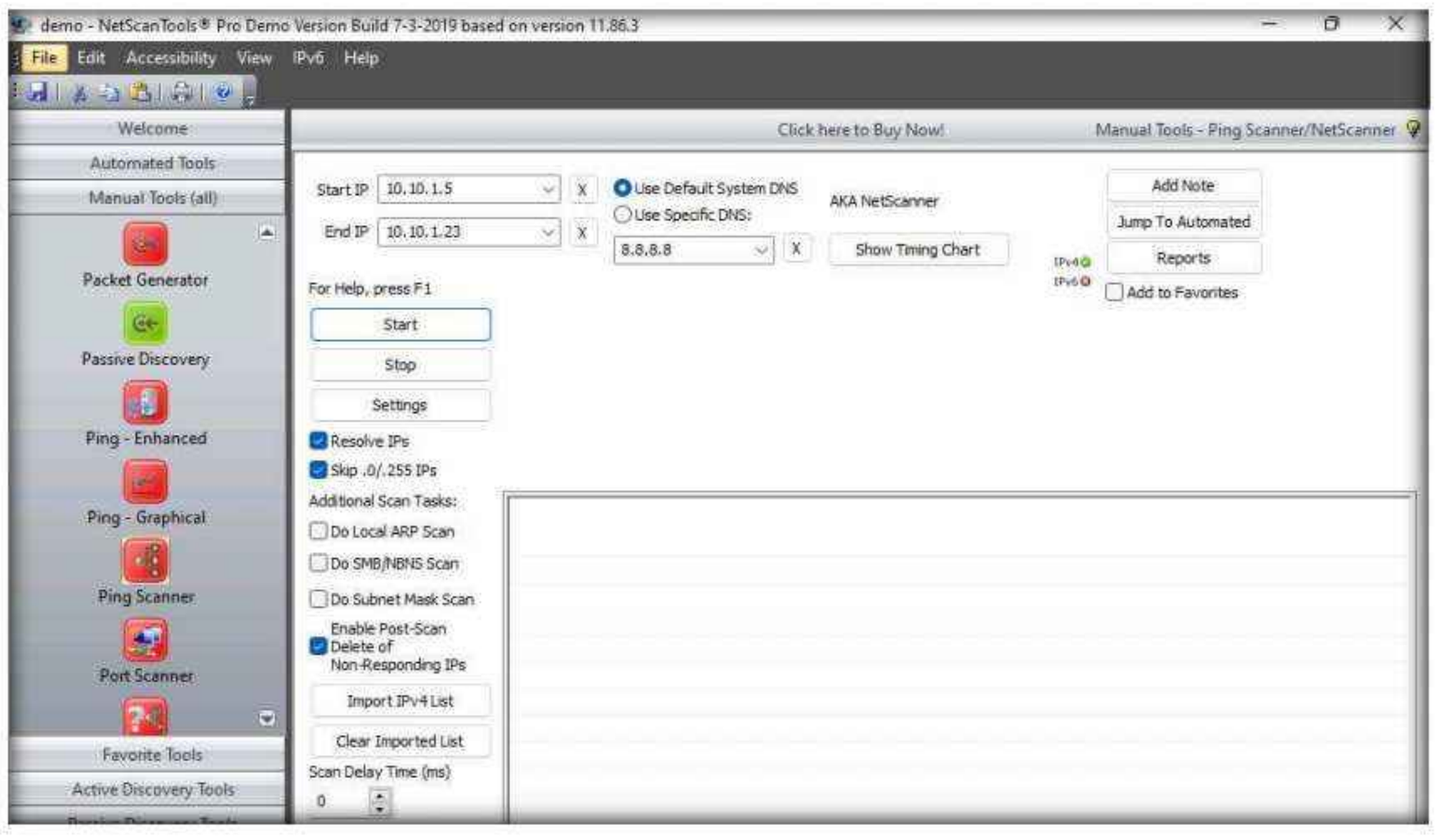


8. In the left-hand pane, under the **Manual Tools (all)** section, scroll down and click the **Ping Scanner** option, as shown in the screenshot.
9. A dialog box opens explaining the **Ping Scanner** tool; click **OK**.



10. Ensure that **Use Default System DNS** is selected. Enter the range of IP addresses into the **Start IP** and **End IP** fields (here, **10.10.1.5** - **10.10.1.23**); then, click **Start**.

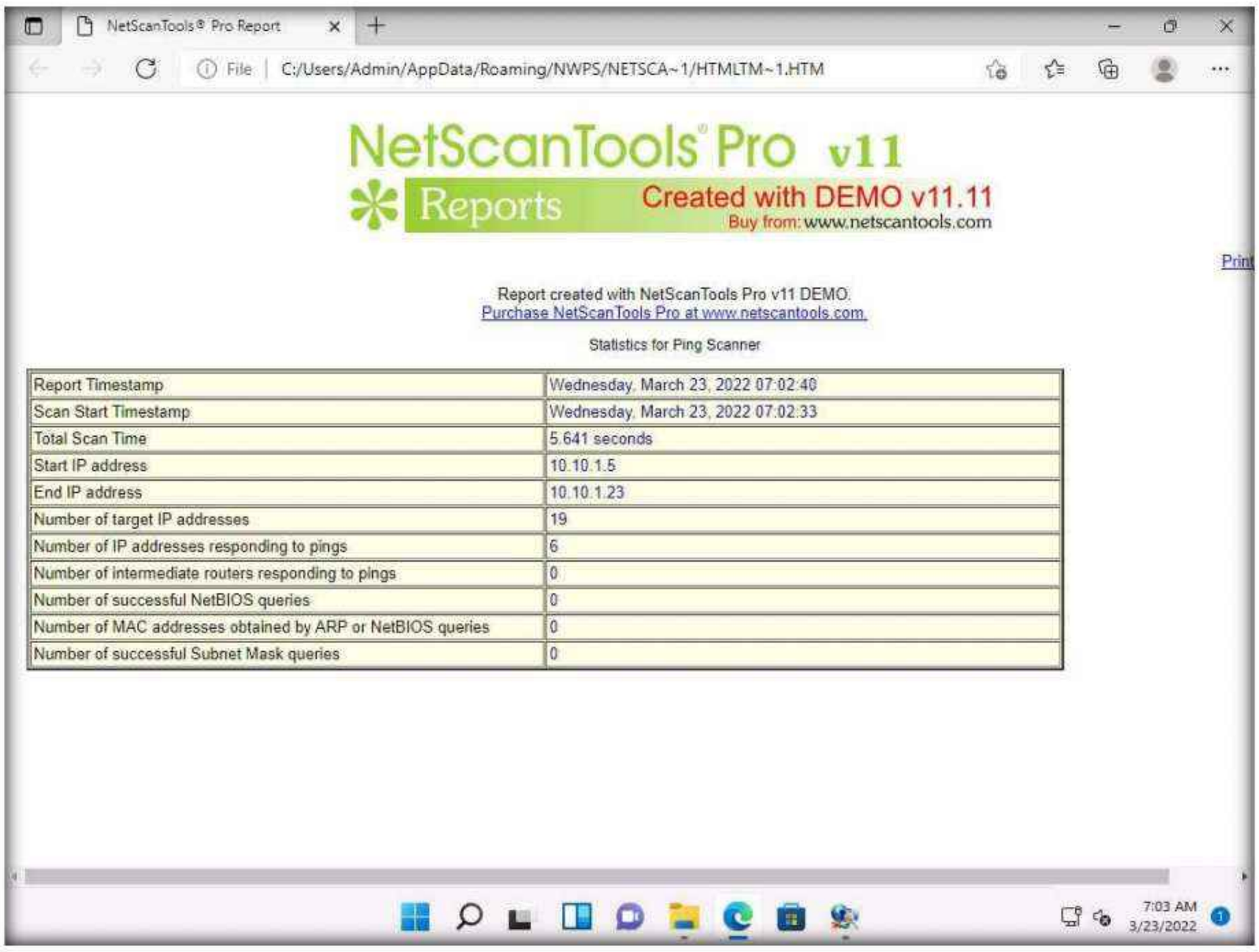
    Note: In this lab task, we are scanning **Parrot Machine**, **Windows Server 2022**, **Windows Server 2019**, and **Android** machines.



11. A **Ping Scanner** notice pop-up appears; click **I Accept**.

12. After the completion of the scan, a scan result appears in the web browser (here, **Google Chrome**).

    Note: If **How do you want to open this file?** pop-up appears select **Google Chrome** from the list and click on **OK**.

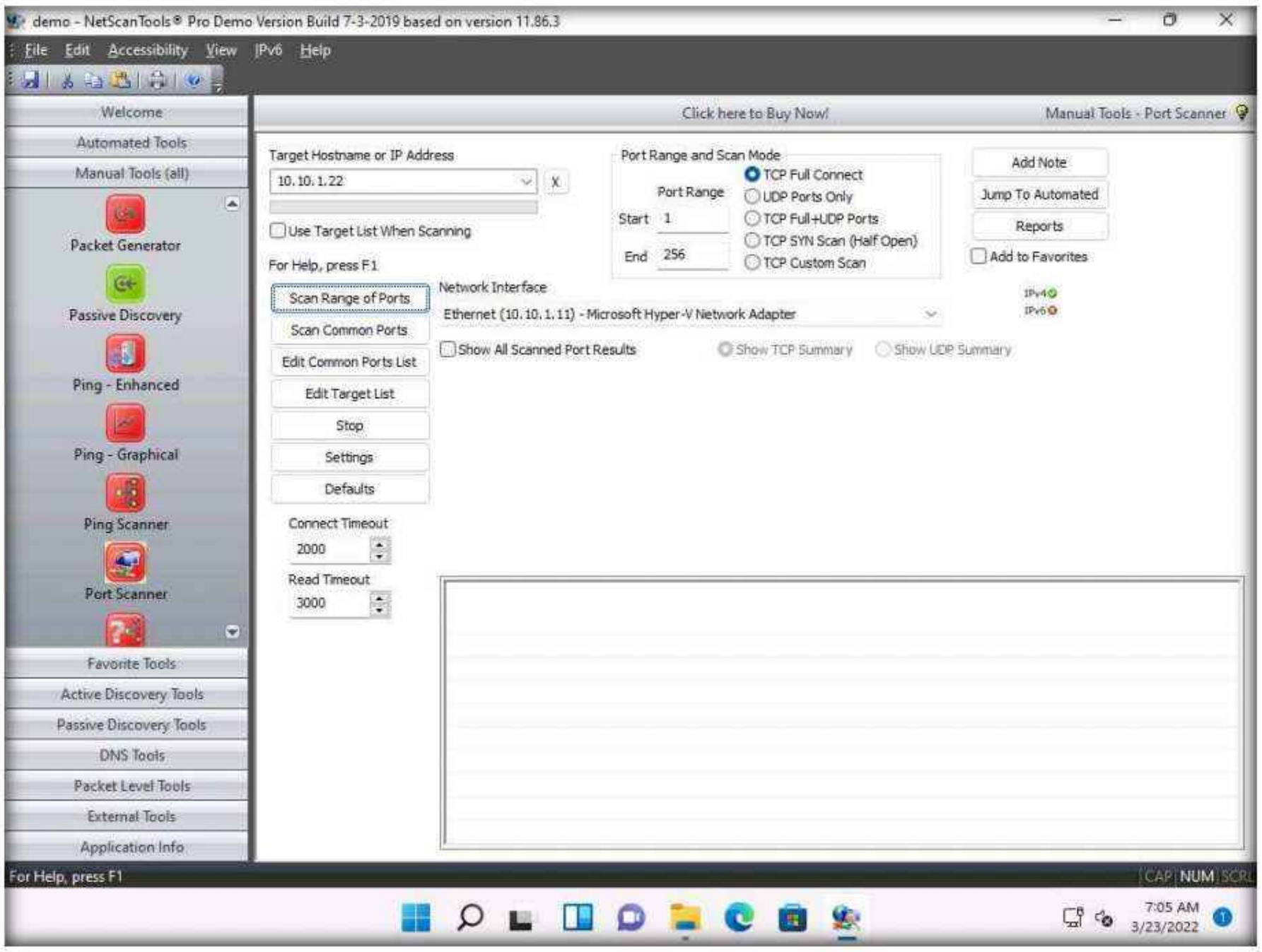


13. Close the browser and switch to the **NetScanTools Pro** window.

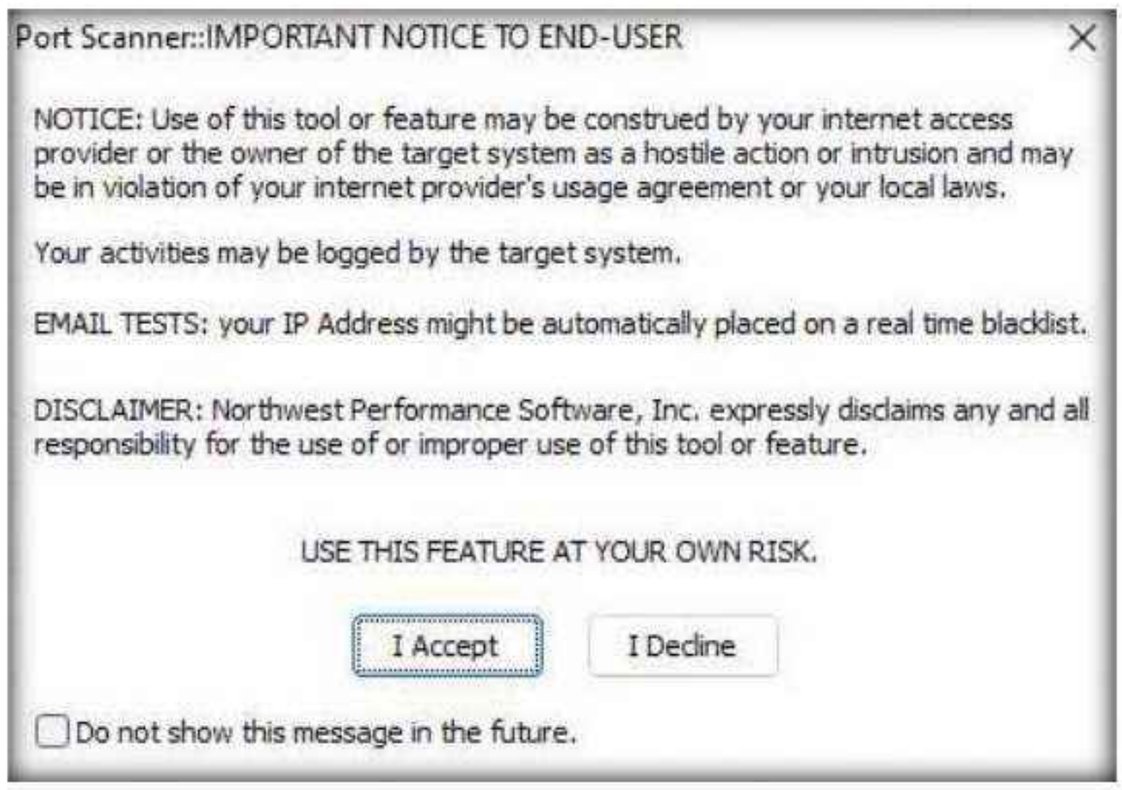
14. Now, click the **Port Scanner** option from the left-hand pane under the **Manual Tools (all)** section.

    Note: If a dialog box appears explaining the **Port Scanner** tool, click **OK**.

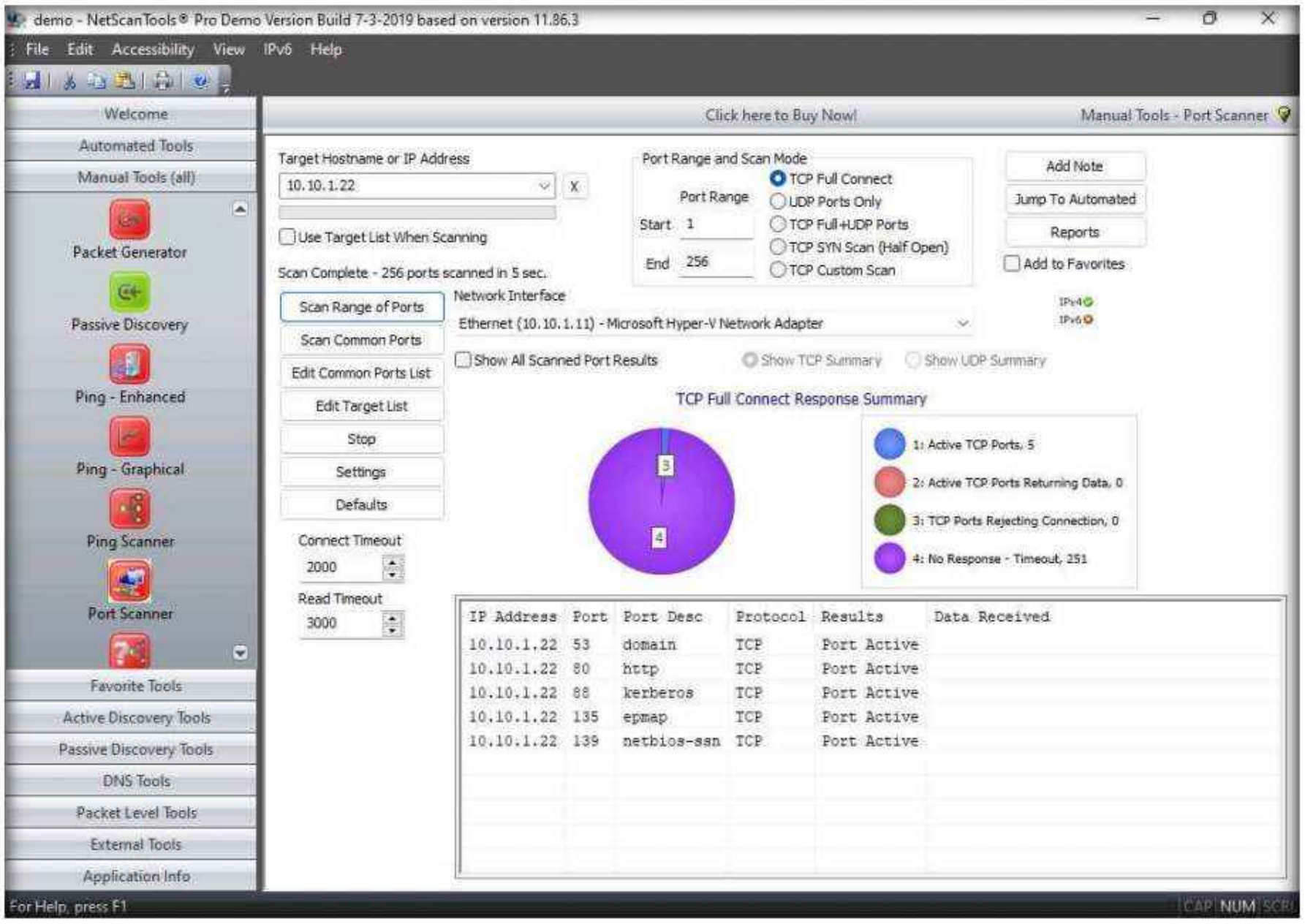
15. In the **Target Hostname or IP Address** field, enter the IP address of the target (here, **10.10.1.22**). Ensure that **TCP Full Connect** radio button is selected, and then click the **Scan Range of Ports** button.



16. A **Port Scanner** notice pop-up appears; click **I Accept**.



17. A result appears displaying the active ports and their descriptions, as shown in the screenshot.



18. By performing the above scans, you will be able to obtain a list of active machines in the network, their respective IP addresses and hostnames, and a list of all the open ports and services that will allow you to choose a target host in order to enter into its network and perform malicious activities such as ARP poisoning, sniffing, etc.
19. This concludes the demonstration of discovering open ports and services running on the target IP address using NetScanTools Pro.
20. Close all open windows and document all the acquired information.

Task 3: Perform Port Scanning using sx Tool

The sx tool is a command-line network scanner that can be used to perform ARP scans, ICMP scans, TCP SYN scans, UDP scans and application scans such as SOCS5 scan, Docker scan and Elasticsearch scan.

Here, we will use sx to perform ARP scans, TCP scans and UDP scans to discover open ports in the target machine.

1. Ensure that the virtual machines (**Windows 11**, **Windows Server 2022**, **Windows Server 2019**, **Ubuntu**, and **Android**) are running.
2. Switch to the **Parrot Security** virtual machine.

3. In the login page, the **attacker** username will be selected by default. Enter password as **toor** in the **Password** field and press **Enter** to log in to the machine.

   Note: If a **Parrot Updater** pop-up appears at the top-right corner of **Desktop**, ignore and close it.

   Note: If a **Question** pop-up window appears asking you to update the machine, click **No** to close the window.

4. Click the **MATE Terminal** icon at the top of the **Desktop** to open a **Terminal** window.

5. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.

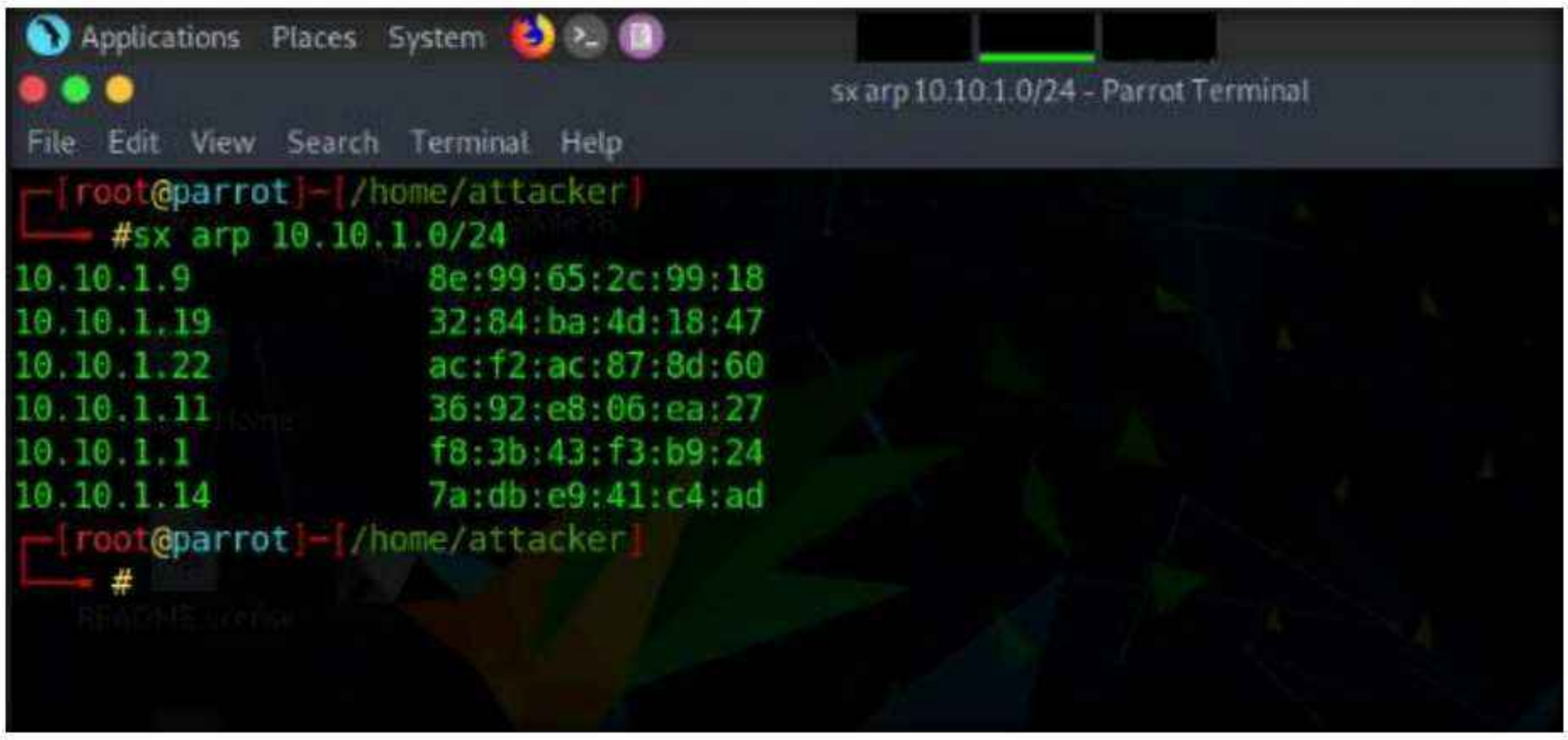
6. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.

7. In the terminal window, type **sx arp [Target subnet]** and press **Enter** (here, the target subnet is **10.10.1.0/24**) to scan all the IP addresses and MAC addresses associated with the connected devices in a local network).

   Note: **arp**: performs an ARP scan.

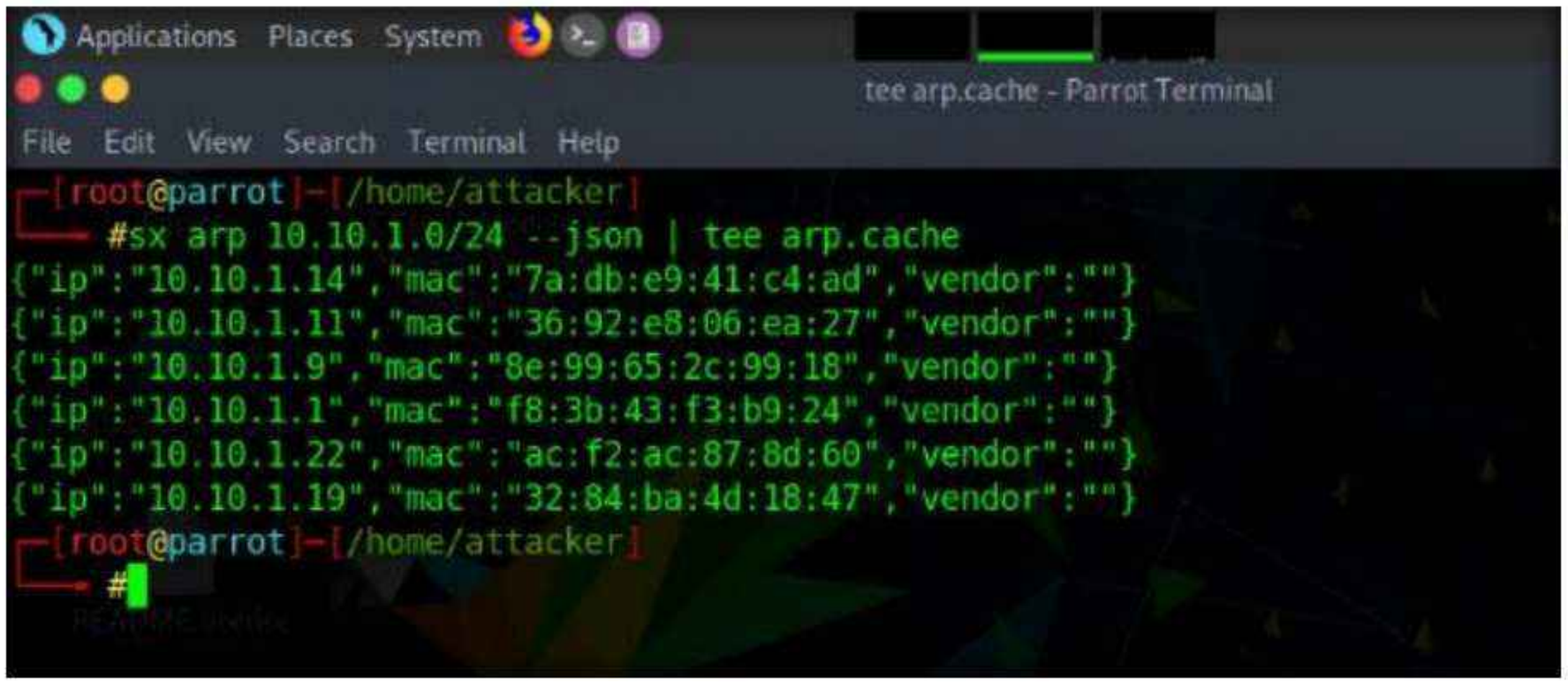
   Note: The MAC addresses might vary when you perform this task.



8. Type **sx arp [Target subnet] --json | tee arp.cache** and press **Enter** to create arp.cache file (here, the target subnet is **10.10.1.0/24**).

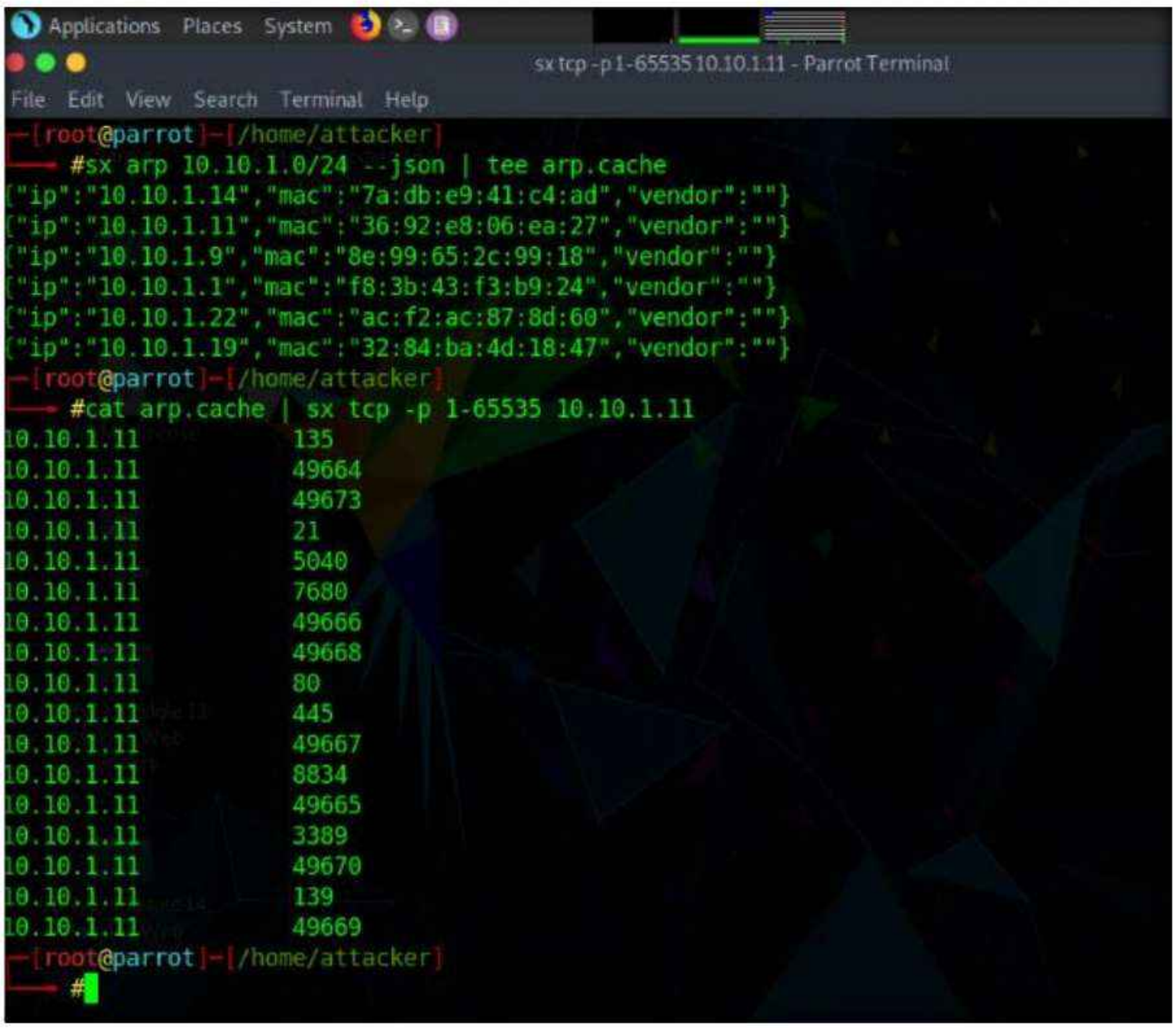
   Note: **--json** converts a text file to the JSON format, **tee** writes the data to stdin.

   Note: Before the actual scan, sx explicitly creates an ARP cache file which is a simple text file containing a JSON string on each line and has the same JSON fields as the ARP scan JSON output. The protocols such as TCP and UDP read the ARP cache file from stdin and then begin the scan.

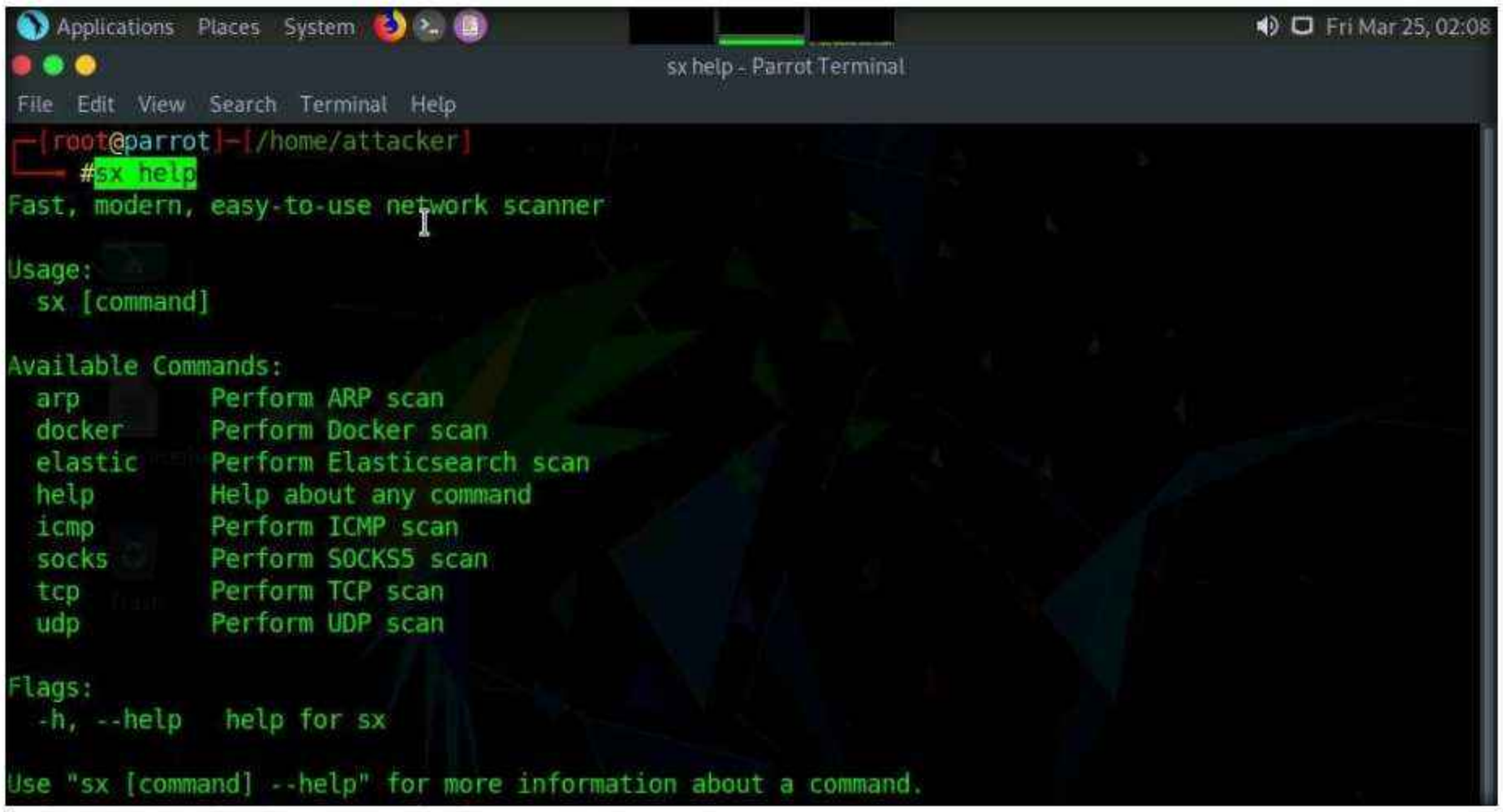


9. Type **cat arp.cache | sx tcp -p 1-65535 [Target IP address]** and press **Enter** to list all the open tcp ports on the target machine (here, the target IP address is **10.10.1.11**).

   Note: **tcp**: performs a TCP scan, **-p**: specifies the range of ports to be scanned (here, the range is **1-65535**).



10. In the terminal, type **sx help** and press **Enter** to obtain the list of commands that can be used. For more information, you can further use **sx --help** command.



11. Now, let us perform UDP scan on the target machine to check if a port is open or closed.
12. In the terminal, type **cat arp.cache | sx udp --json -p [Target Port] 10.10.1.11** and press **Enter** (here, target port is **53**).

    Note: **udp**: performs a UDP scan, **-p** specifies the target port.

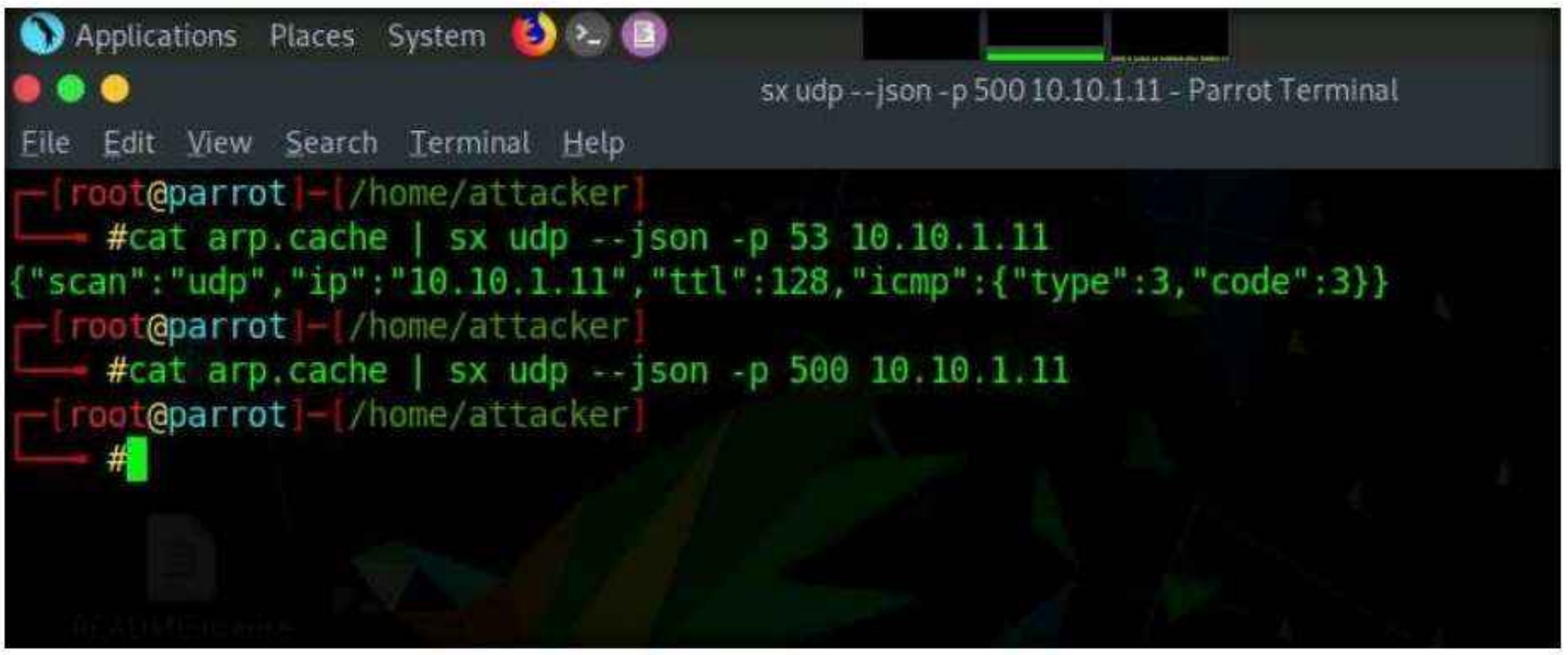
    Note: In a UDP scan **sx** returns the IP address, ICMP packet type and code set to the reply packet.

13. The result appears, with the reply packet from the host with **Destination Unreachable** type (**3**) and **Port Unreachable** code (**3**), which indicates that the target port is closed.

    Note: - According to **RFC1122**, a host should generate Destination Unreachable messages with code: 2 (Protocol Unreachable), when the designated transport protocol is not supported; or 3 (Port Unreachable), when the designated transport protocol (e.g., UDP) is unable to demultiplex the datagram but has no protocol mechanism to inform the sender.

    - According to **RFC792**, network unreachable error is specified with code: 0, Host unreachable error with code: 1, Protocol unreachable error with code: 2, Port unreachable error with code 3.

14. Type **cat arp.cache | sx udp --json -p [Target Port] 10.10.1.11** and press **Enter** (here, the target port is **500**).



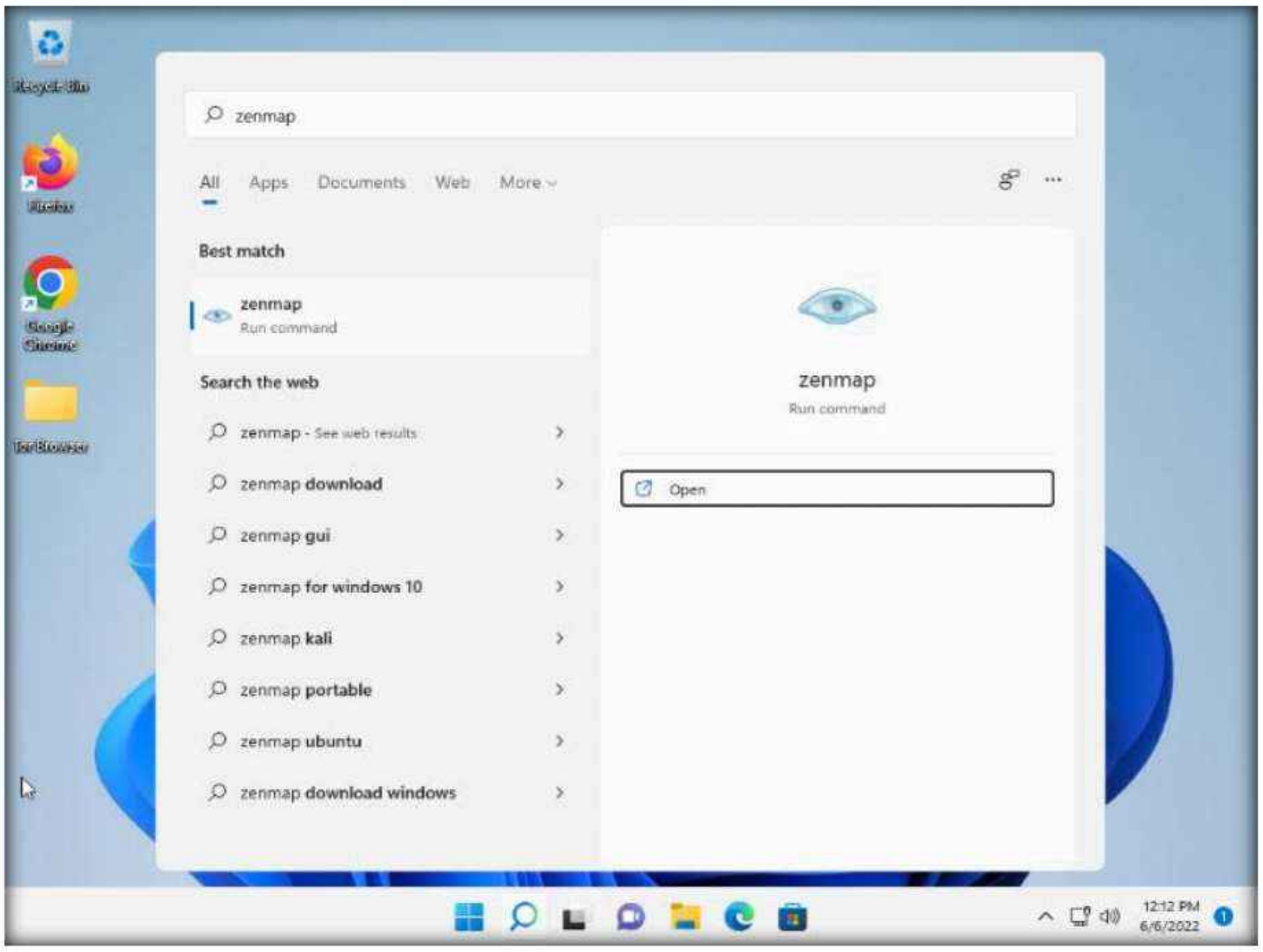
15. You can observe that sx does not return any code in the above command, which states that the target port is open.
16. This concludes the demonstration of port scanning using sx Tool.
17. Close all open windows and document all acquired information.
18. Turn off the virtual machines (**Windows Server 2019**, **Android**, and **Parrot Security**).

Task 4: Explore Various Network Scanning Techniques using Nmap

Nmap comes with various inbuilt scripts that can be employed during a scanning process in an attempt to find the open ports and services running on the ports. It sends specially crafted packets to the target host, and then analyzes the responses to accomplish its goal. Nmap includes many port scanning mechanisms (TCP and UDP), OS detection, version detection, ping sweeps, etc.

Here, we will use Nmap to discover open ports and services running on the live hosts in the target network.

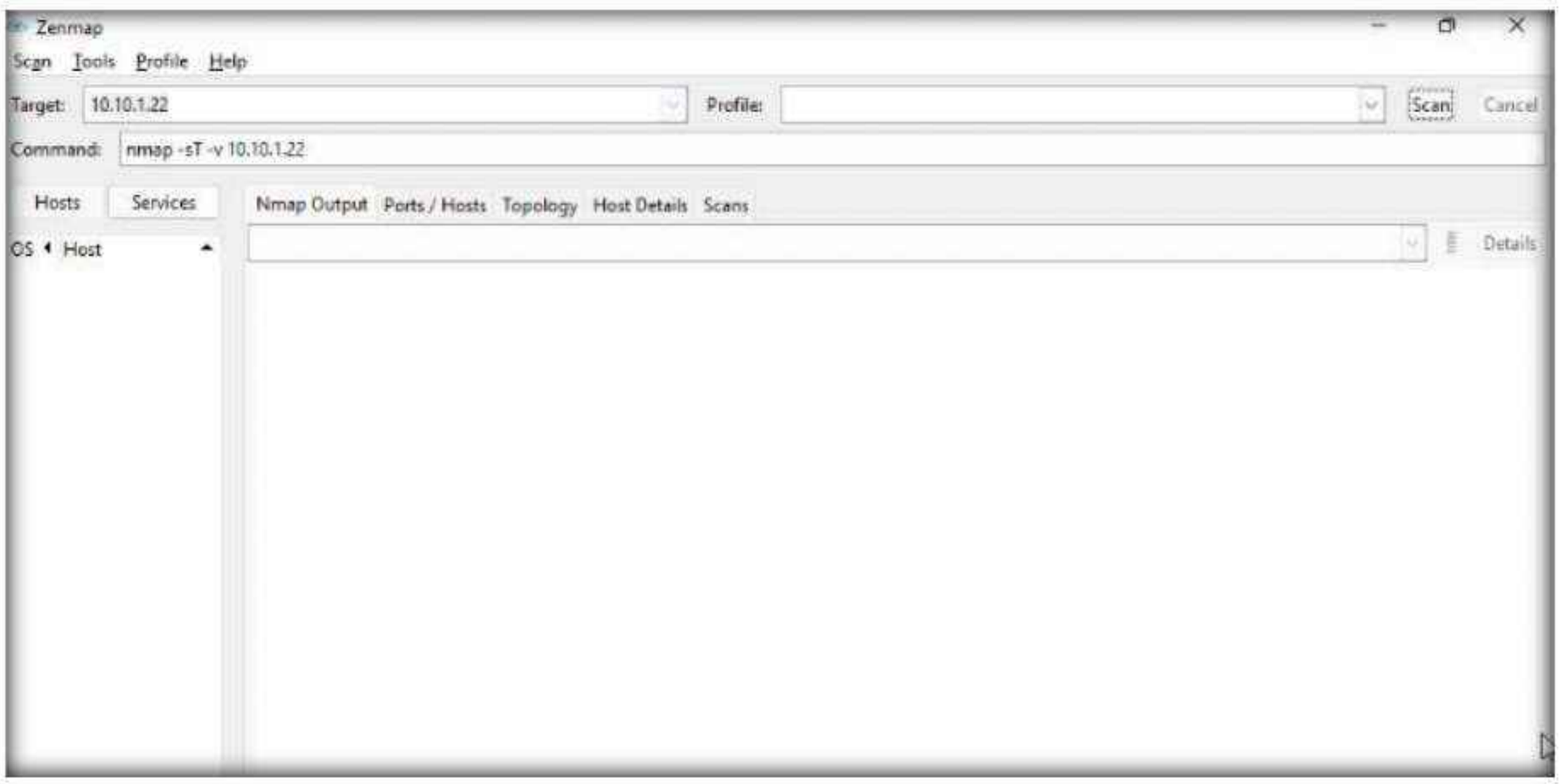
1. Ensure that the **Windows 11**, **Ubuntu** and **Windows Server 2022** virtual machines are running.
2. Switch to the **Windows 11** virtual machine. In the **Windows 11** machine, click **Search** icon () on the **Desktop**. Type **zenmap** in the search field, the **Zenmap** appears in the results, click **Open** to launch it.



3. The **Zenmap** appears; in the **Command** field, type the command **nmap -sT -v [Target IP Address]** (here, the target IP address is **10.10.1.22**) and click **Scan**.

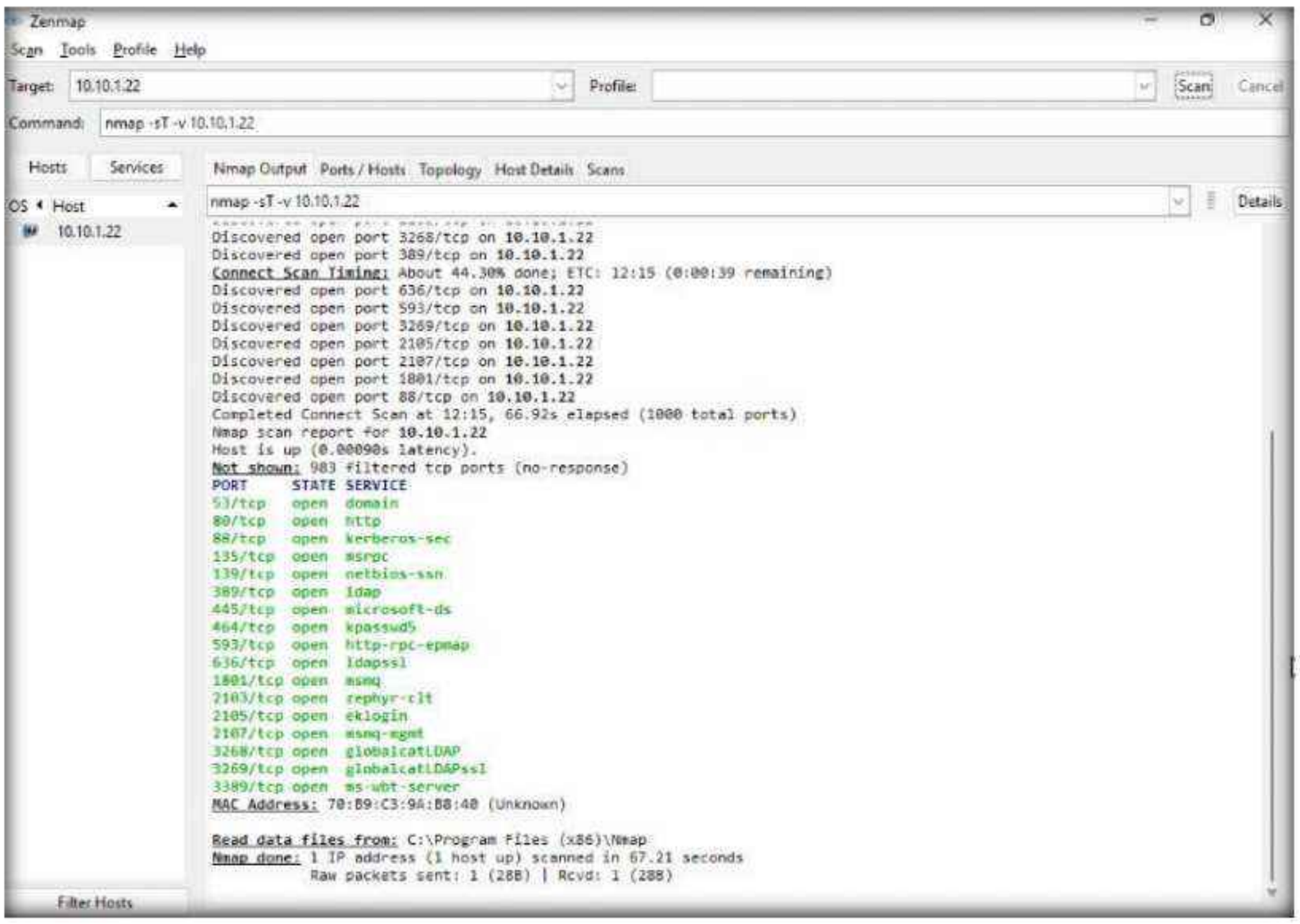
   Note: **-sT**: performs the TCP connect/full open scan and **-v**: enables the verbose output (include all hosts and ports in the output).

   Note: The MAC addresses might differ when you perform the task.

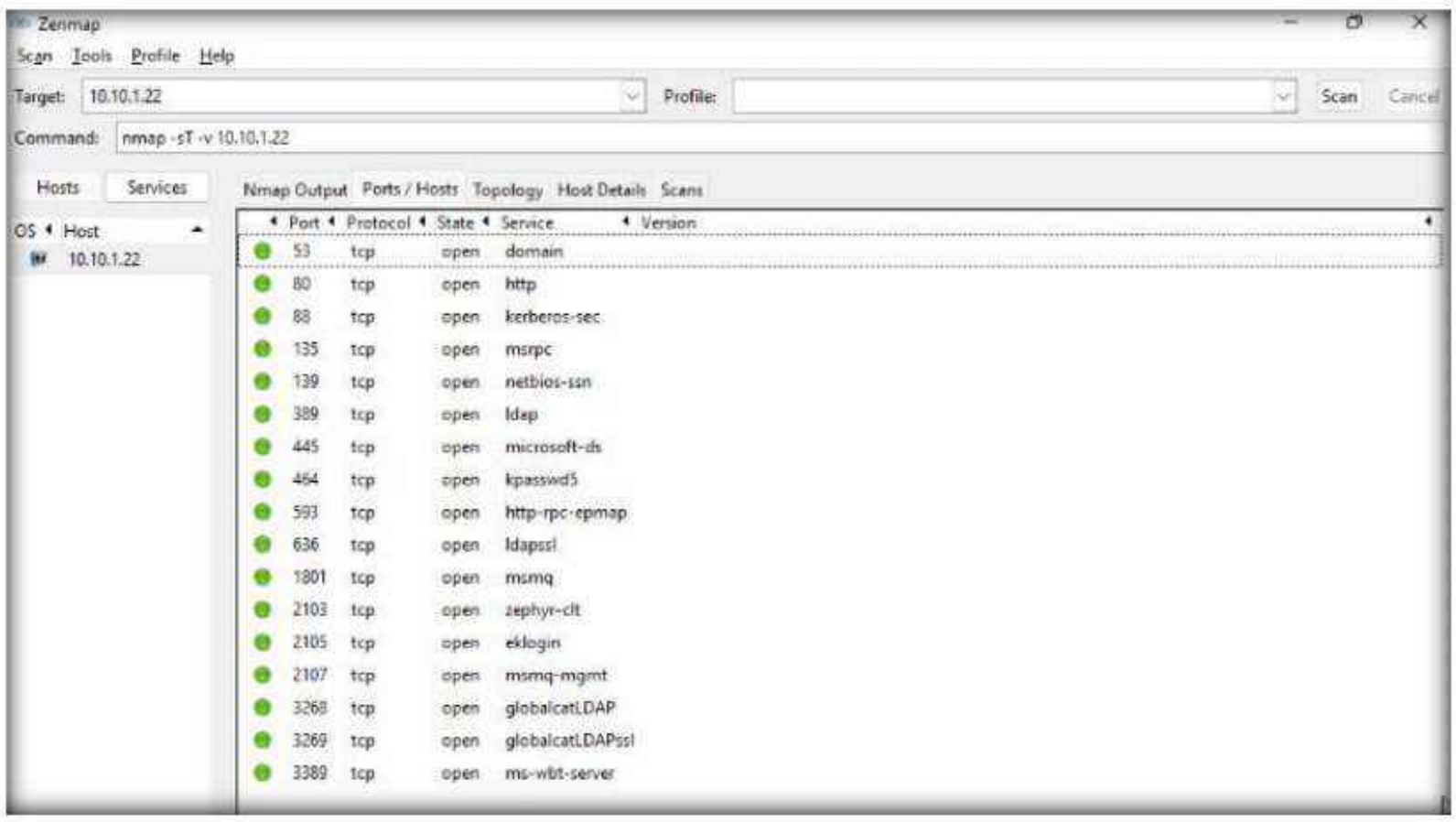


4. The scan results appear, displaying all the open TCP ports and services running on the target machine, as shown in the screenshot.

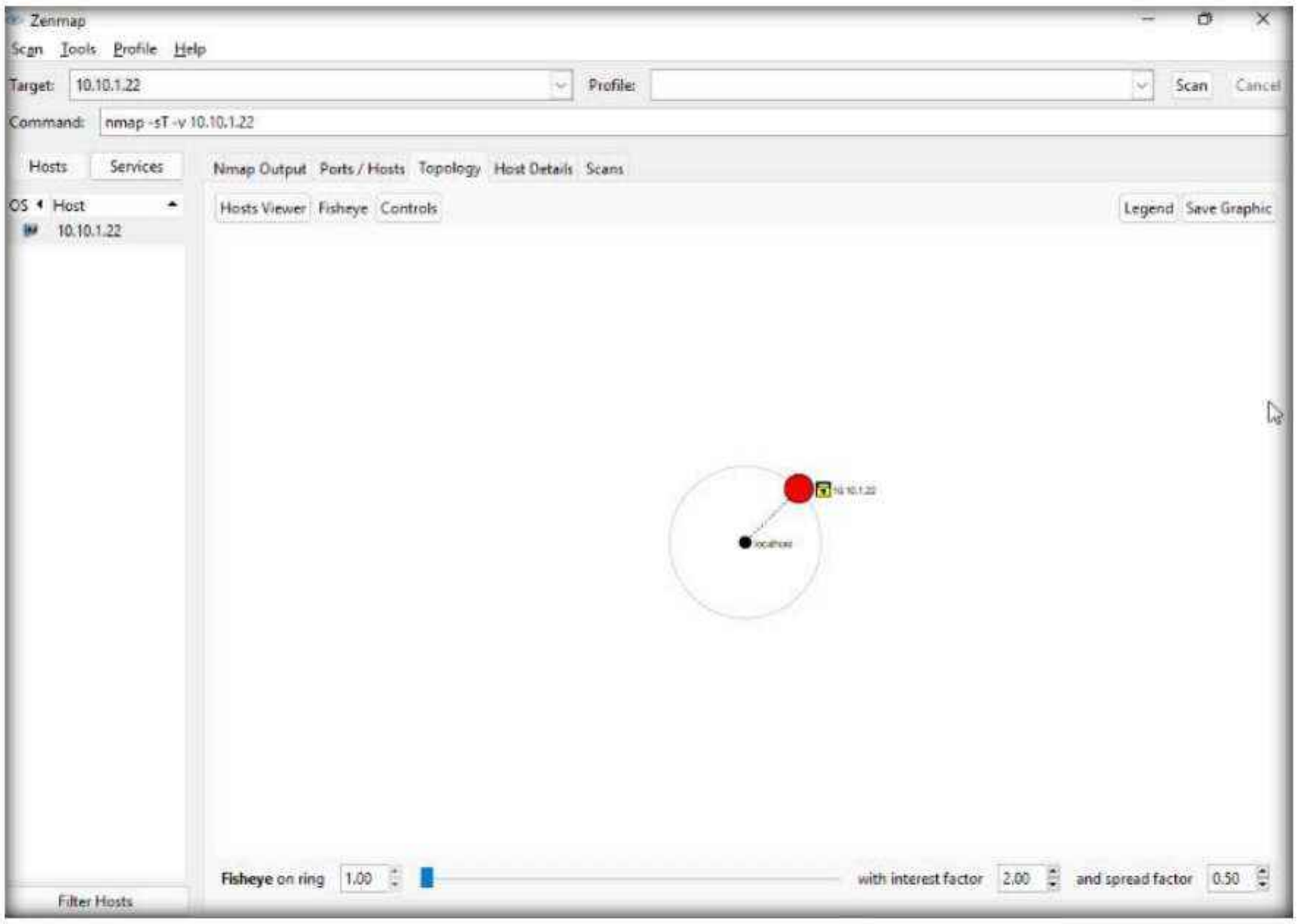
   Note: TCP connect scan completes a three-way handshake with the target machine. In the TCP three-way handshake, the client sends a SYN packet, which the recipient acknowledges with the SYN+ACK packet. In turn, the client acknowledges the SYN+ACK packet with an ACK packet to complete the connection. Once the handshake is completed, the client sends an RST packet to end the connection.



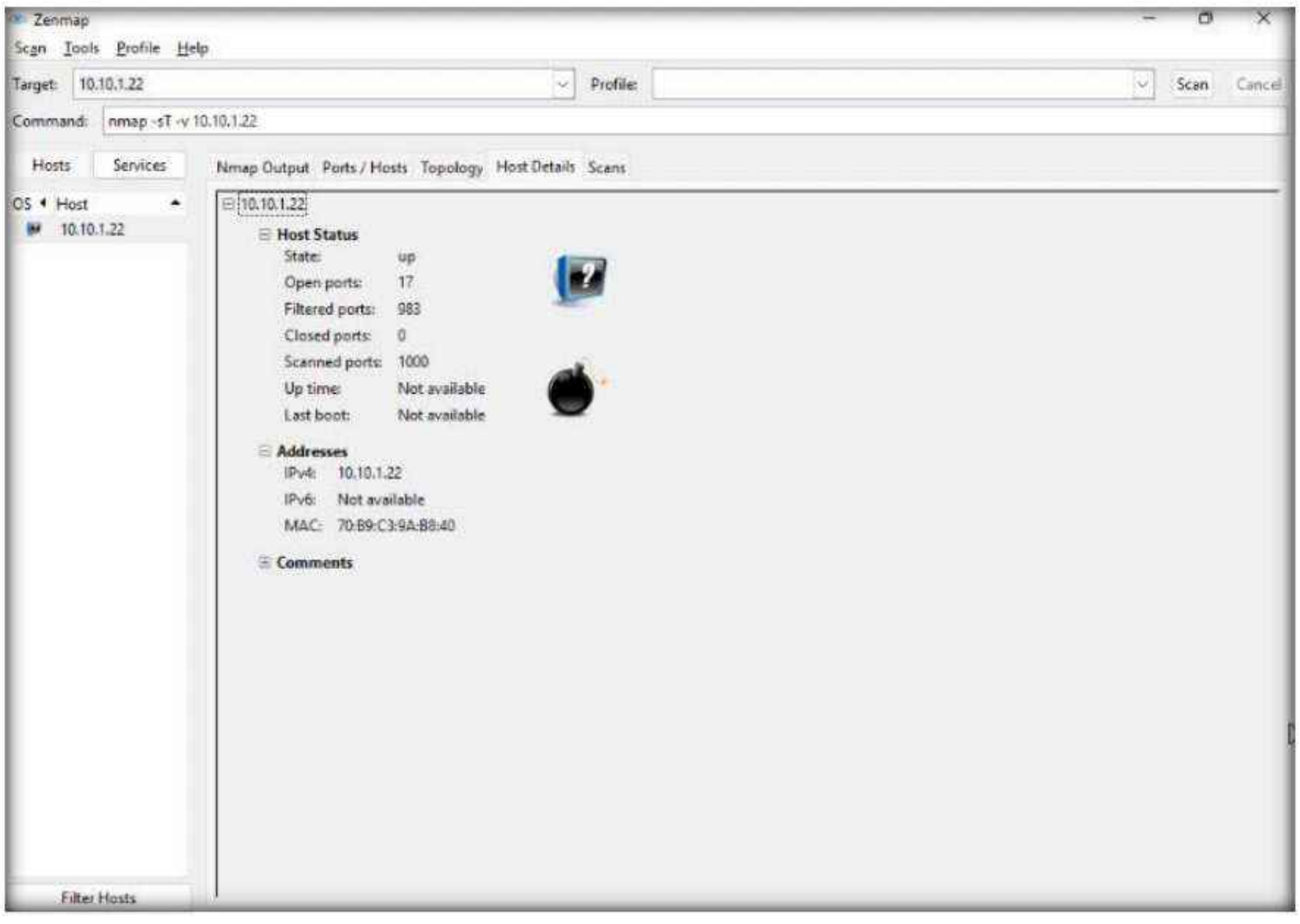
5. Click the **Ports/Hosts** tab to gather more information on the scan results. Nmap displays the Port, Protocol, State, Service, and Version of the scan.



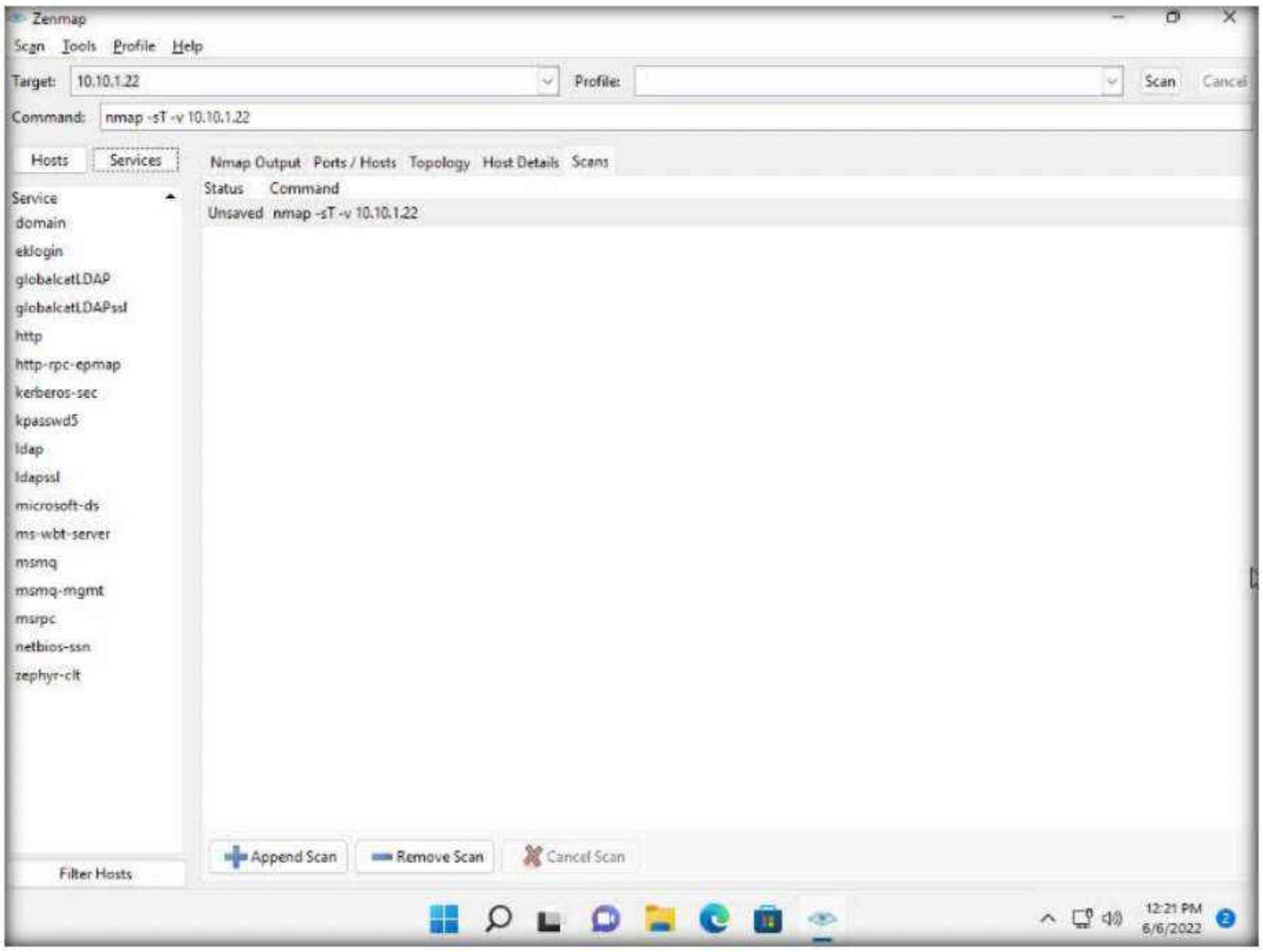
6. Click the **Topology** tab to view the topology of the target network that contains the provided IP address and click the **Fisheye** option to view the topology clearly.



7. In the same way, click the **Host Details** tab to view the details of the TCP connect scan.



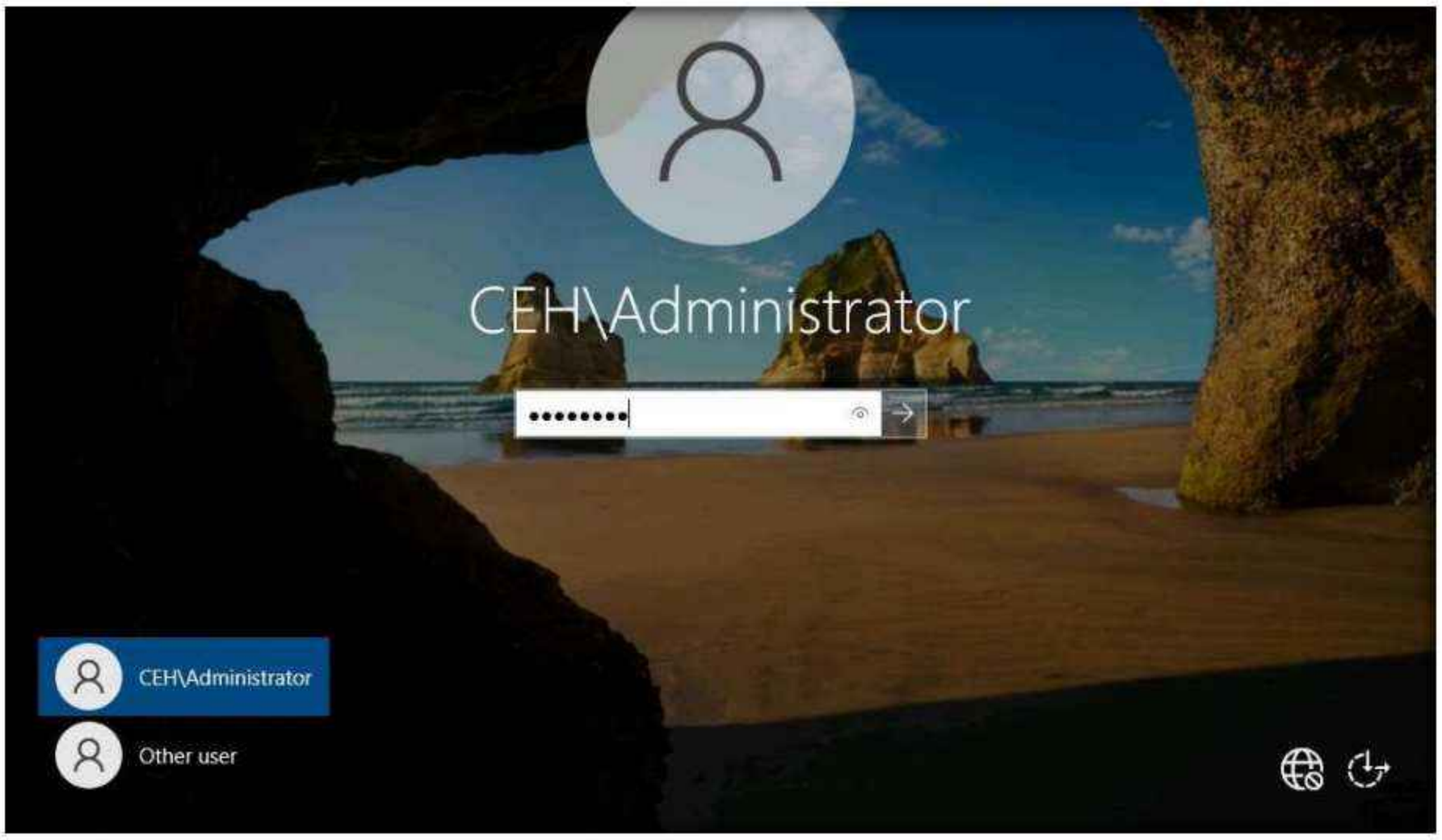
8. Click the **Scans** tab to view the command used to perform TCP connect/full open scan.
9. Click the **Services** tab located in the left pane of the window. This tab displays a list of services.



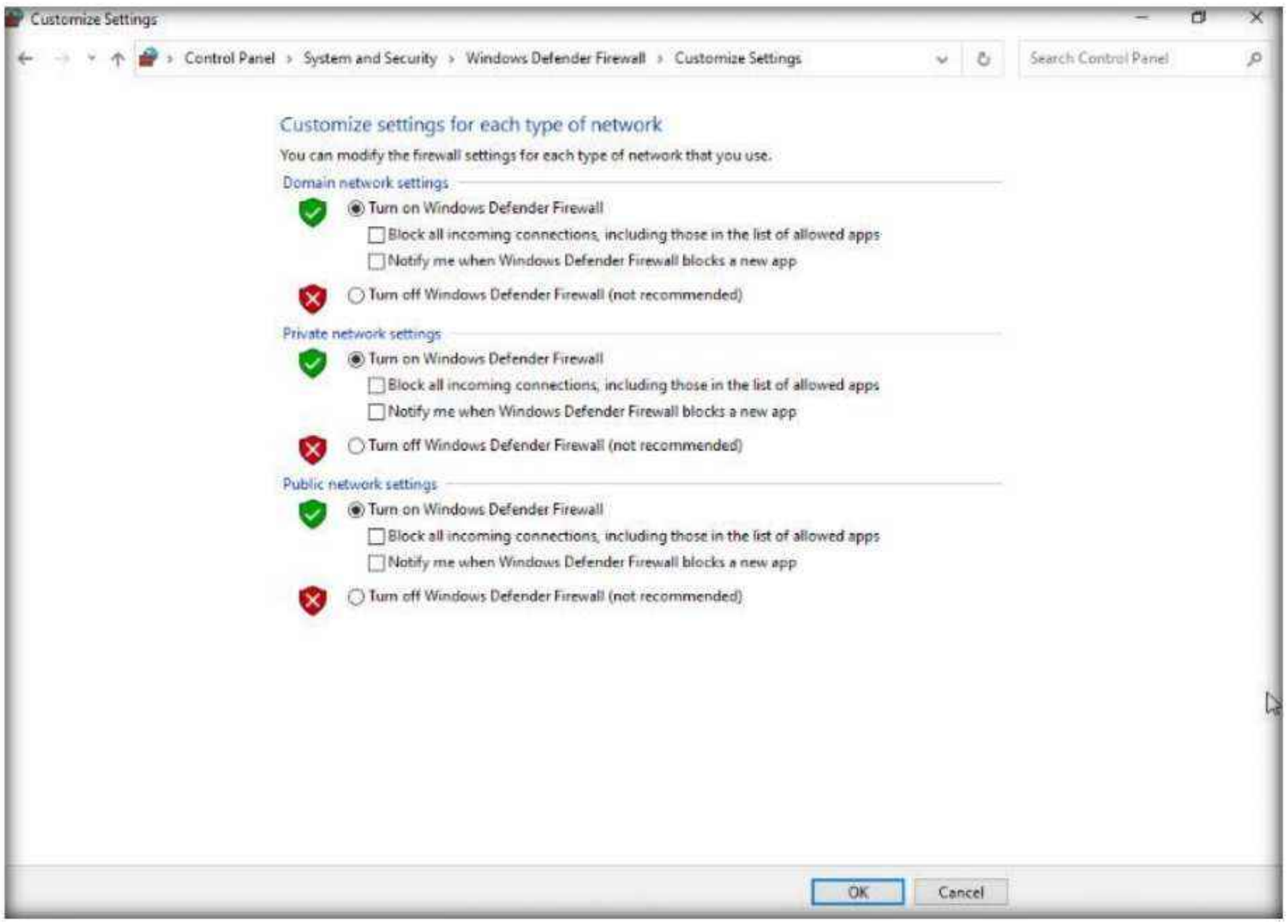
Note: You can use any of these services and their open ports to enter into the target network/host and establish a connection.

10. In this sub-task, we shall be performing a stealth scan/TCP half-open scan, Xmas scan, TCP Maimon scan, and ACK flag probe scan on a firewall-enabled machine (i.e., **Windows Server 2022**) in order to observe the result. To do this, we need to enable **Windows Firewall** in the **Windows Server 2022** machine.
11. Switch to the **Windows Server 2022** virtual machine.

12. Click **Ctrl+Alt+Del** to activate the machine. By default, **CEH\Administrator** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.



13. Navigate to **Control Panel → System and Security → Windows Defender Firewall → Turn Windows Defender Firewall on or off**, enable Windows Firewall and click **OK**, as shown in the screenshot.

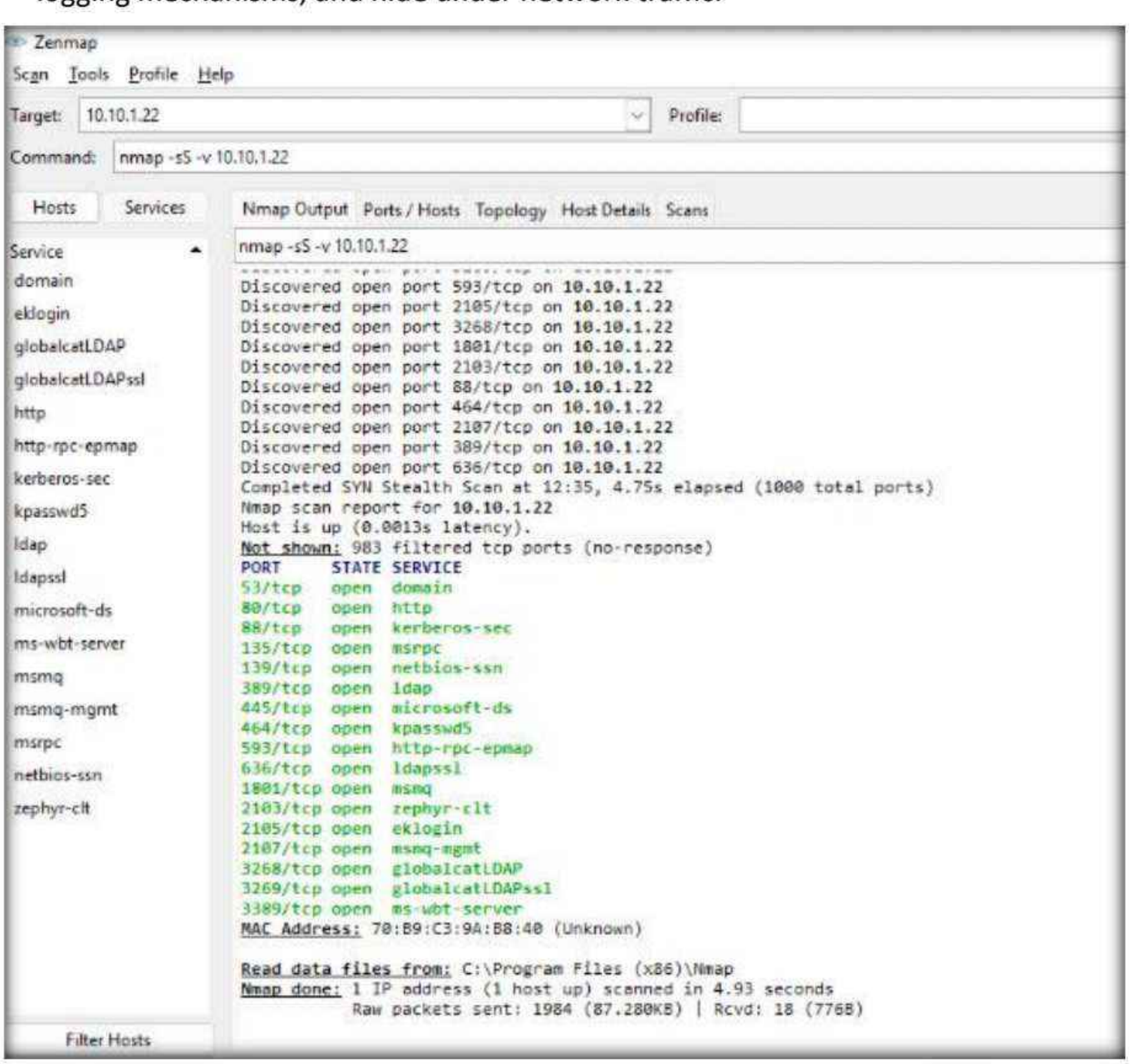


14. Now, switch to the **Windows 11** virtual machine. In the **Command** field of **Zenmap**, type the command **nmap -sS -v [Target IP Address]** (here, the target IP address is **10.10.1.22**) and click **Scan**.

    Note: **-sS**: performs the stealth scan/TCP half-open scan and **-v**: enables the verbose output (include all hosts and ports in the output).

15. The scan results appear, displaying all open TCP ports and services running on the target machine, as shown in the screenshot.

    Note: The stealth scan involves resetting the TCP connection between the client and server abruptly before completion of three-way handshake signals, and hence leaving the connection half-open. This scanning technique can be used to bypass firewall rules, logging mechanisms, and hide under network traffic.



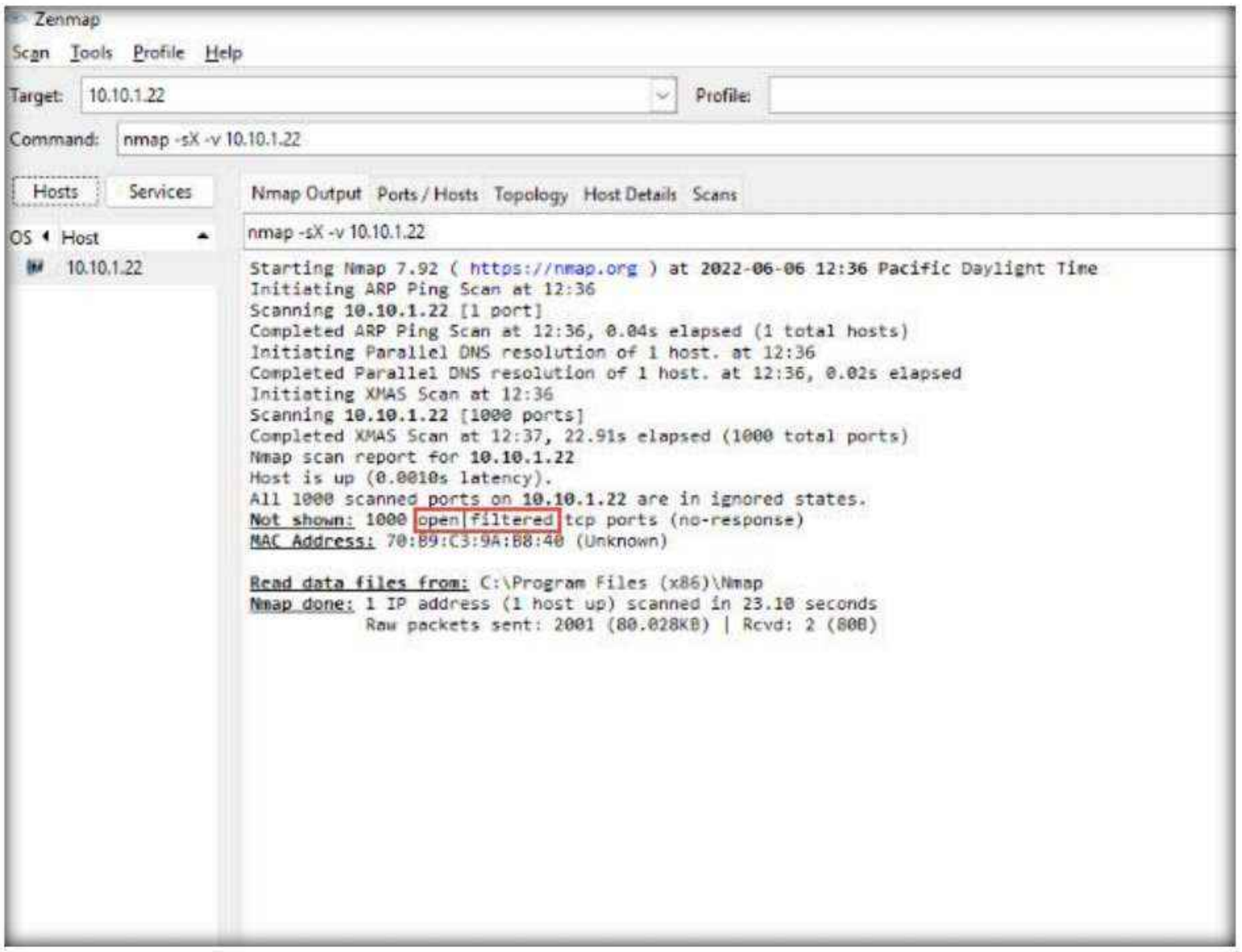
16. As shown in the last task, you can gather detailed information from the scan result in the **Ports/Hosts**, **Topology**, **Host Details**, and **Scan** tab.

17. In the **Command** field of **Zenmap**, type the command **nmap -sX -v [Target IP Address]** (here, the target IP address is **10.10.1.22**) and click **Scan**.

    Note: **-sX**: performs the Xmas scan and **-v**: enables the verbose output (include all hosts and ports in the output).

18. The scan results appear, displaying that the ports are either open or filtered on the target machine, which means a firewall has been configured on the target machine.

    Note: Xmas scan sends a TCP frame to a target system with FIN, URG, and PUSH flags set. If the target has opened the port, then you will receive no response from the target system. If the target has closed the port, then you will receive a target system reply with an RST.

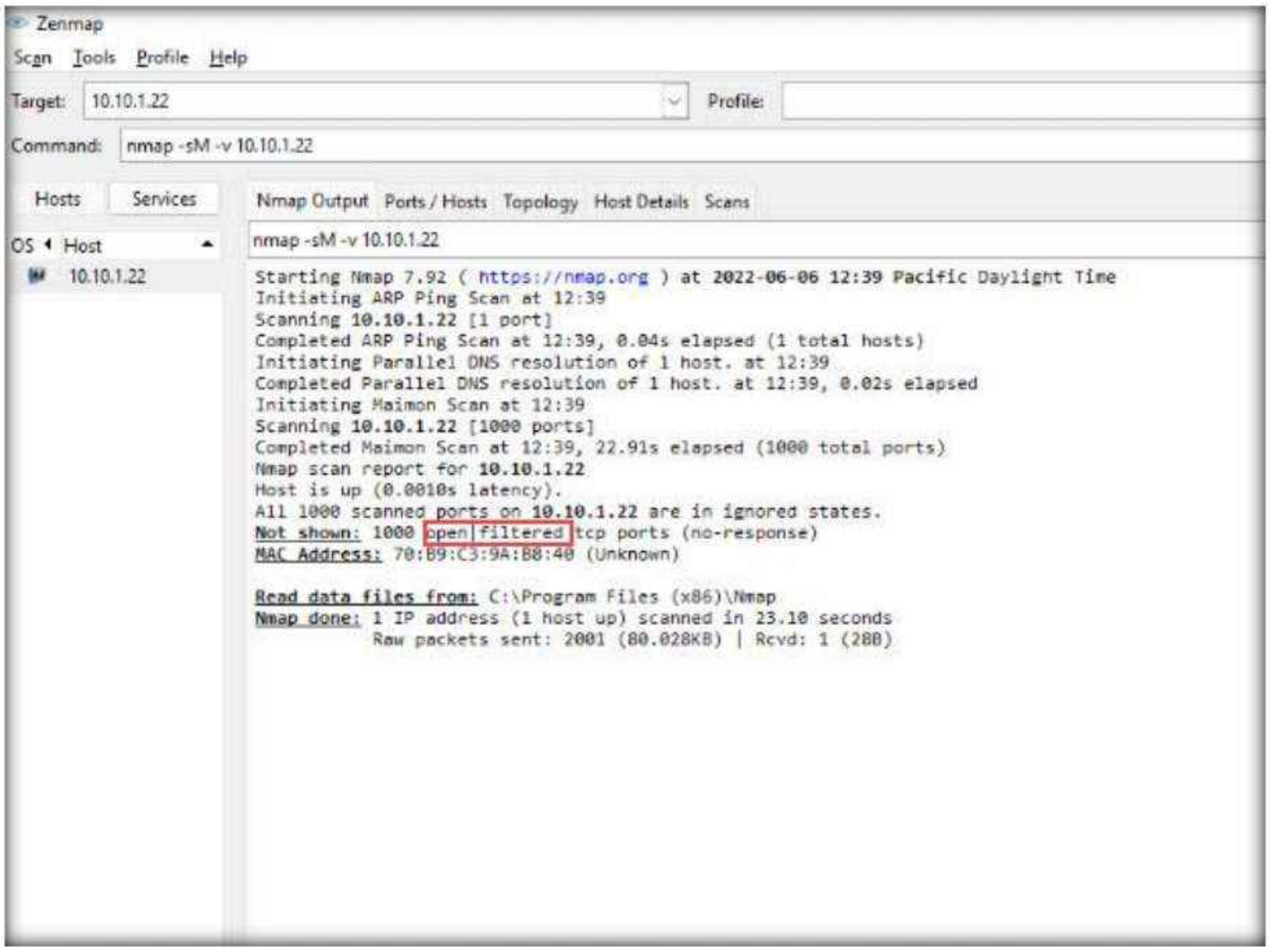


19. In the **Command** field, type the command **nmap -sM -v [Target IP Address]** (here, the target IP address is **10.10.1.22**) and click **Scan**.

    Note: **-sM**: performs the TCP Maimon scan and **-v**: enables the verbose output (include all hosts and ports in the output).

20. The scan results appear, displaying either the ports are open/filtered on the target machine, which means a firewall has been configured on the target machine.

    Note: In the TCP Maimon scan, a FIN/ACK probe is sent to the target; if there is no response, then the port is Open|Filtered, but if the RST packet is sent as a response, then the port is closed.

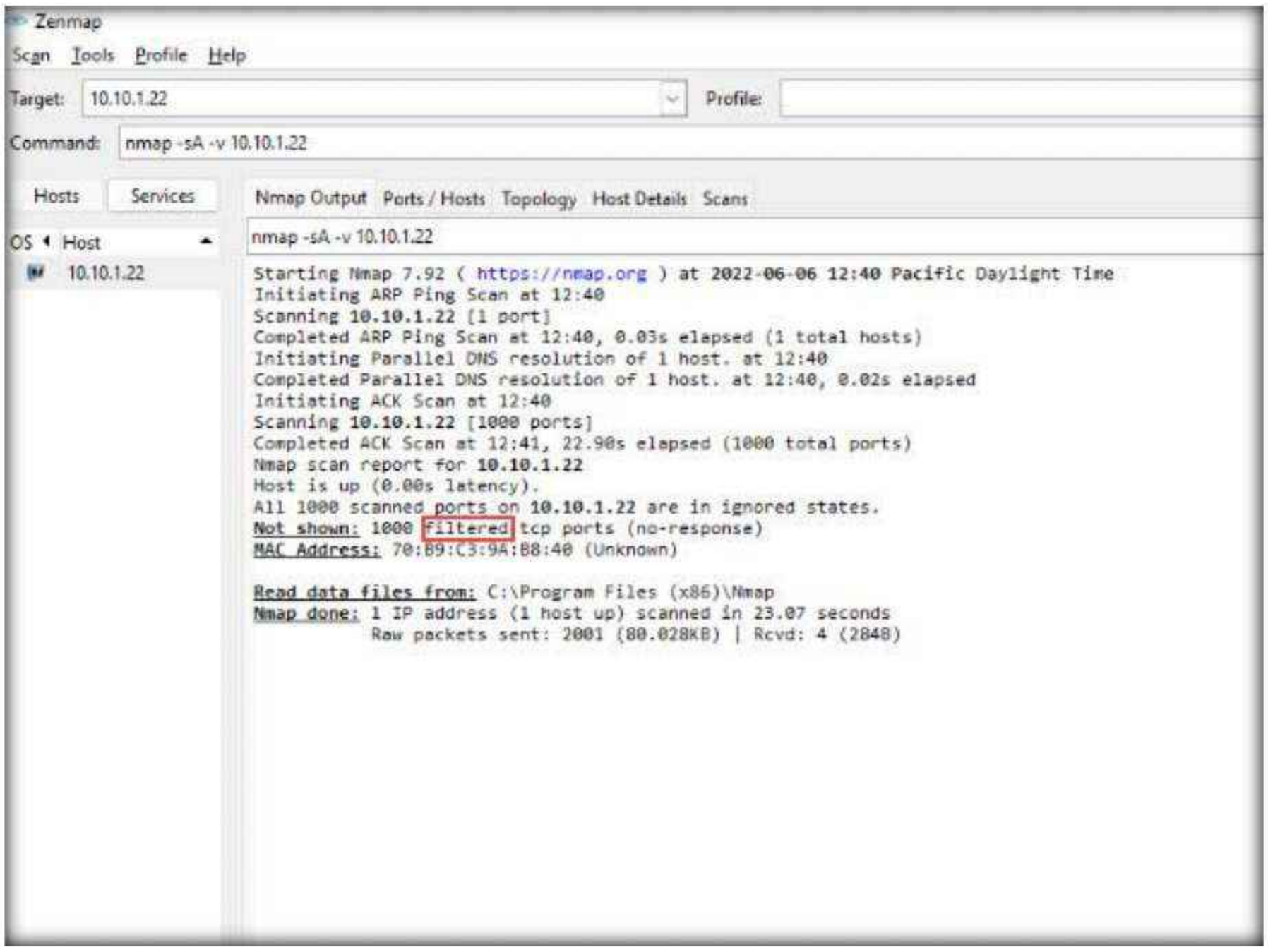


21. In the **Command** field, type the command **nmap -sA -v [Target IP Address]** (here, the target IP address is **10.10.1.22**) and click **Scan**.

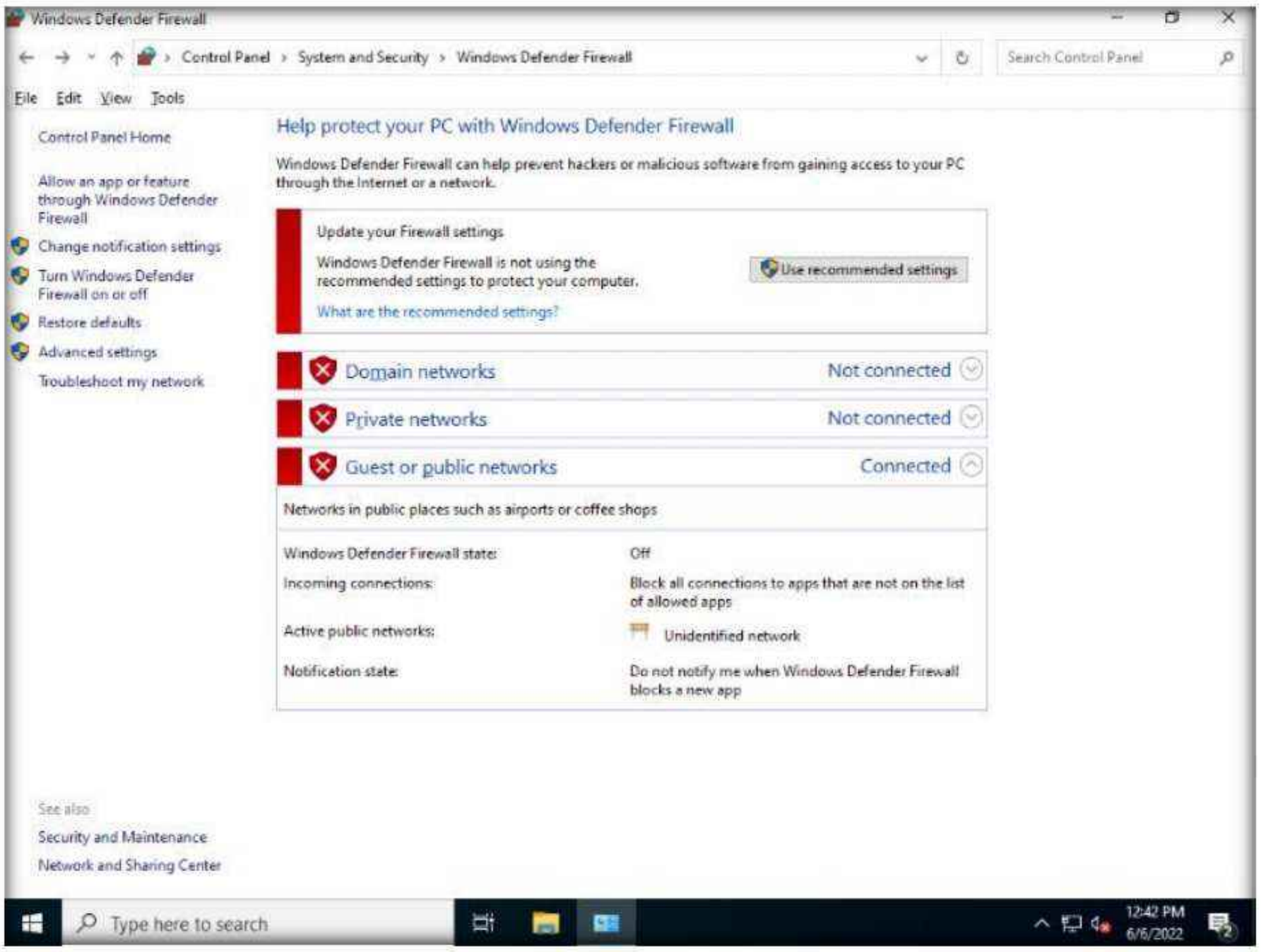
    Note: **-sA**: performs the ACK flag probe scan and **-v**: enables the verbose output (include all hosts and ports in the output).

22. The scan results appear, displaying that the ports are filtered on the target machine, as shown in the screenshot.

    Note: The ACK flag probe scan sends an ACK probe packet with a random sequence number; no response implies that the port is filtered (stateful firewall is present), and an RST response means that the port is not filtered.



23. Switch to the **Windows Server 2022** virtual machine.
24. If you are logged out of the **Windows Server 2022** virtual machine, then click **Ctrl+Alt+Del** to activate the machine. By default, **CEH\Administrator** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.
25. Turn off the **Windows Defender Firewall** from **Control Panel**.



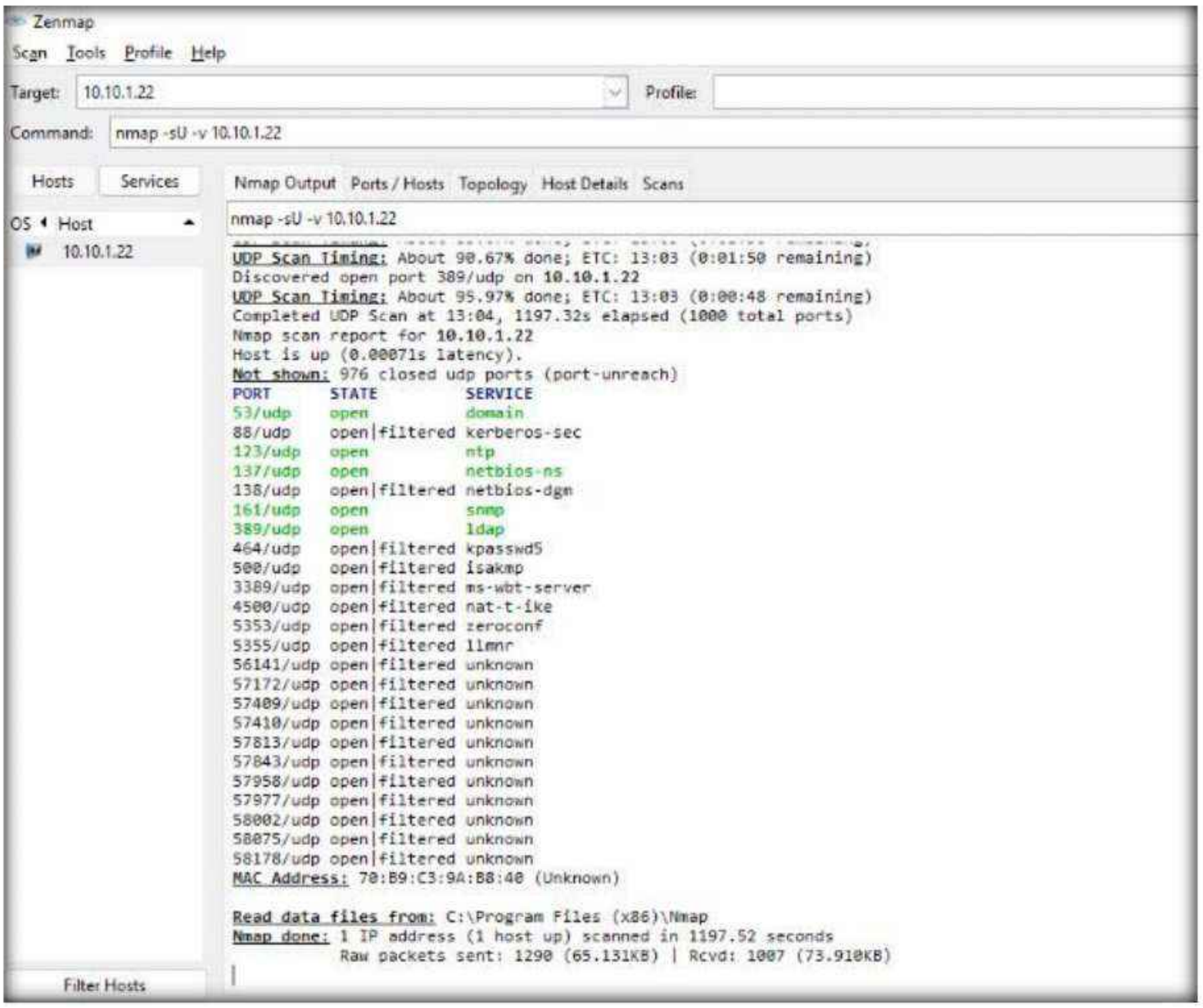
26. Now, switch back to the **Windows 11** virtual machine. In the **Command** field of **Zenmap**, type the command **nmap -sU -v [Target IP Address]** (here, the target IP address is **10.10.1.22**) and click **Scan**.

    Note: **-sU**: performs the UDP scan and **-v**: enables the verbose output (include all hosts and ports in the output).

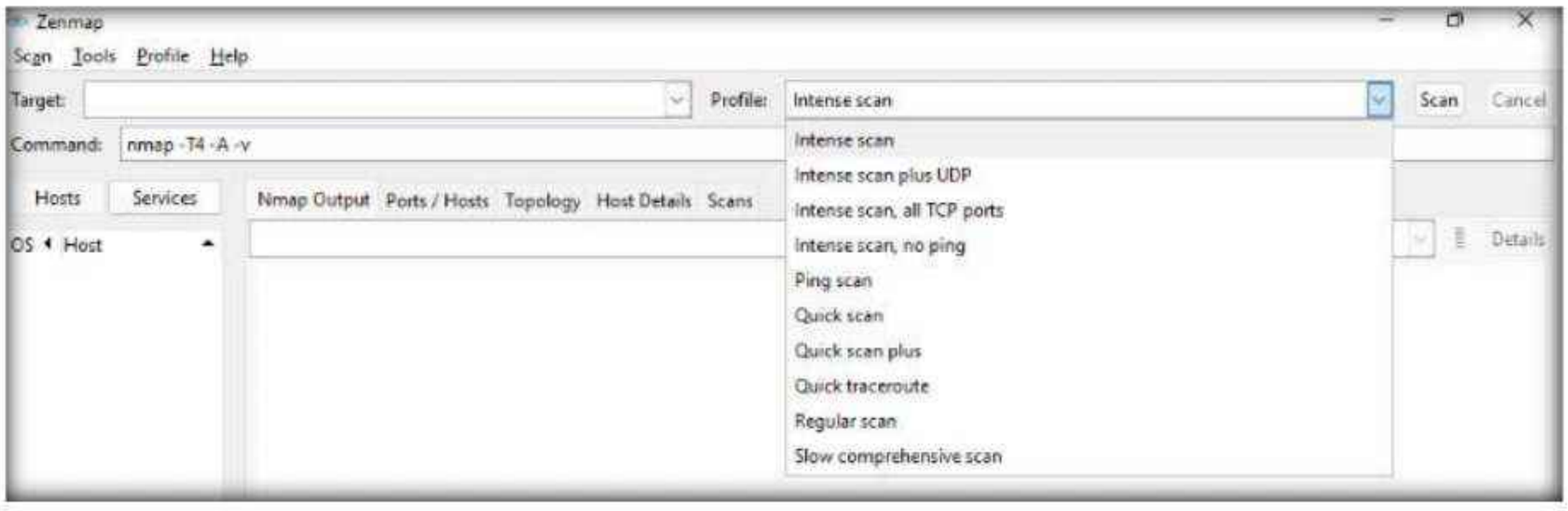
27. The scan results appear, displaying all open UDP ports and services running on the target machine, as shown in the screenshot.

    Note: This scan will take approximately 20 minutes to finish the scanning process and the results might differ in your lab environment.

    Note: The UDP scan uses UDP protocol instead of the TCP. There is no three-way handshake for the UDP scan. It sends UDP packets to the target host; no response means that the port is open. If the port is closed, an ICMP port unreachable message is received.

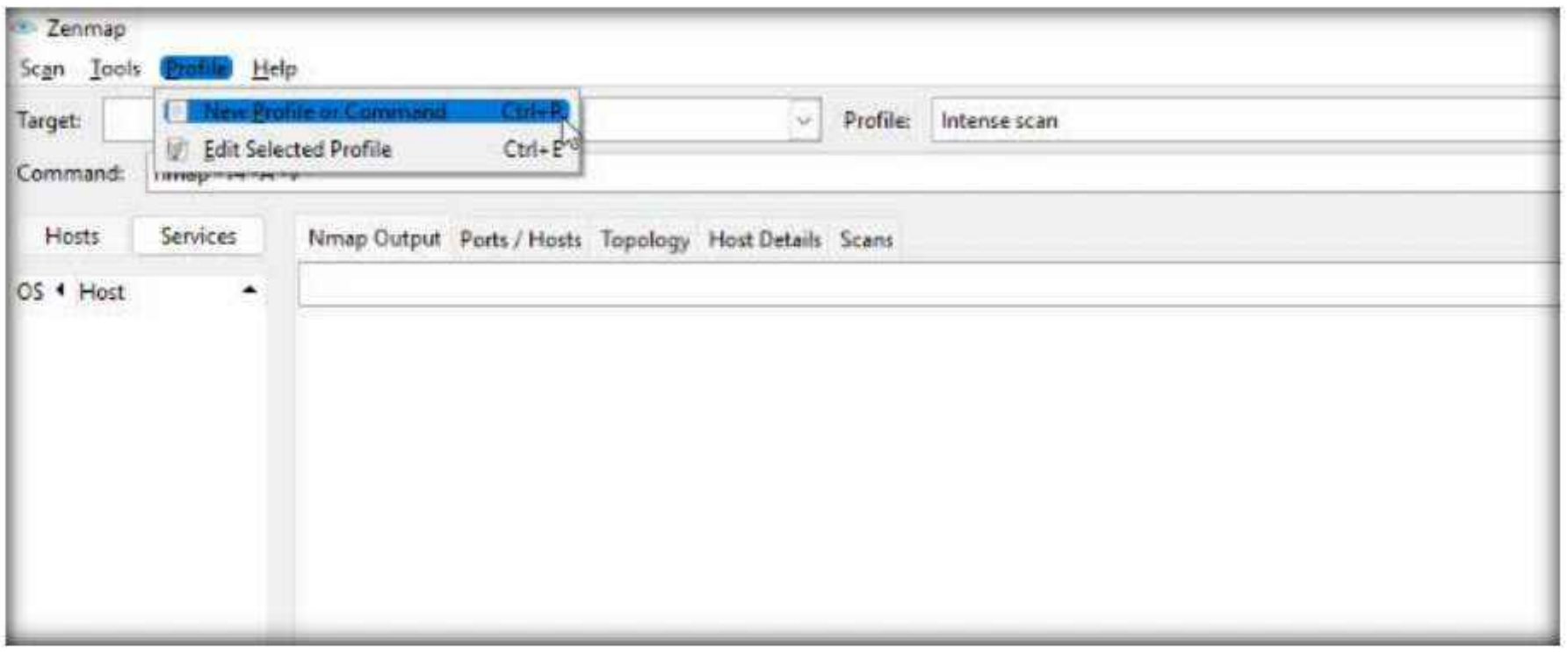


28. Close the **Zenmap** window.
29. You can create your scan profile, or you can also choose the default scan profiles available in Nmap to scan a network.
30. Click **Search** icon () on the **Desktop**. Type **zenmap** in the search field, the **Nmap - Zenmap GUI** appears in the results, click **Open** to launch it.
31. To choose the default scan profiles available in Nmap, click on the drop-down icon in the **Profile** field and select the scanning technique you want to use.

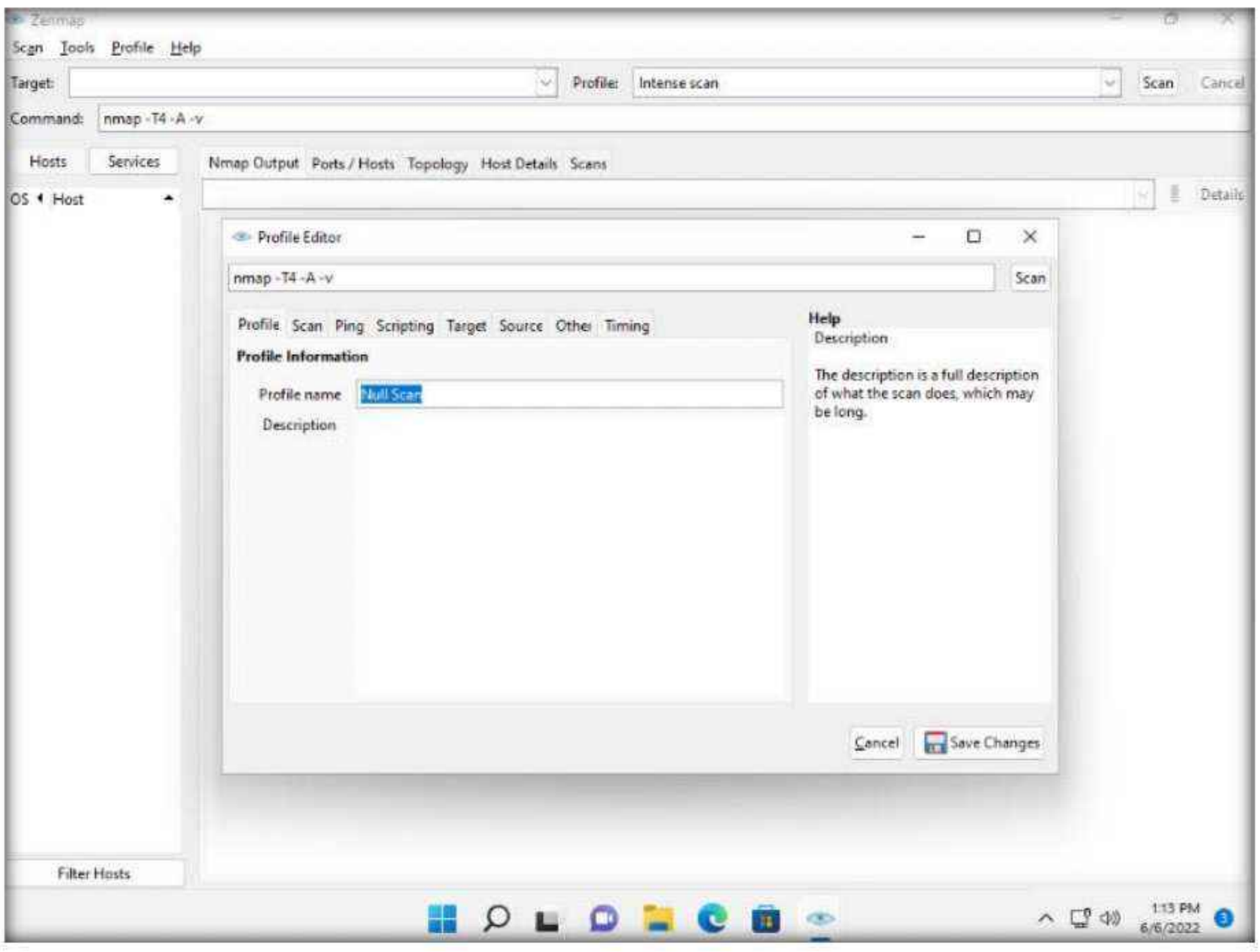


32. To create a scan profile; click **Profile → New Profile or Command**.

    Note: If a **User Account Control** pop-up appears, click **Yes**.

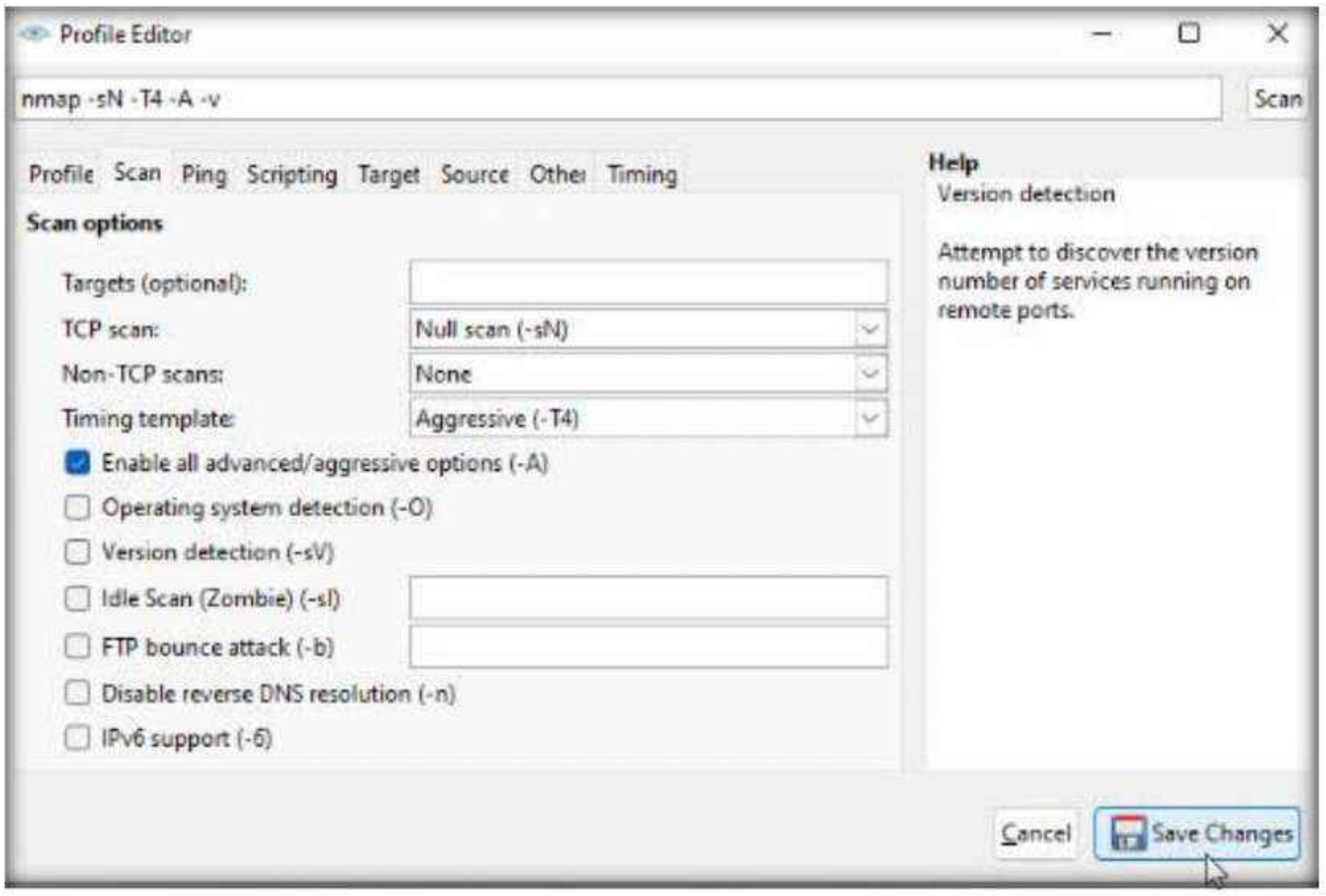


33. The **Profile Editor** window appears. In the **Profile** tab, under the **Profile Information** section, input a profile name (here, **Null Scan**) into the **Profile name** field.

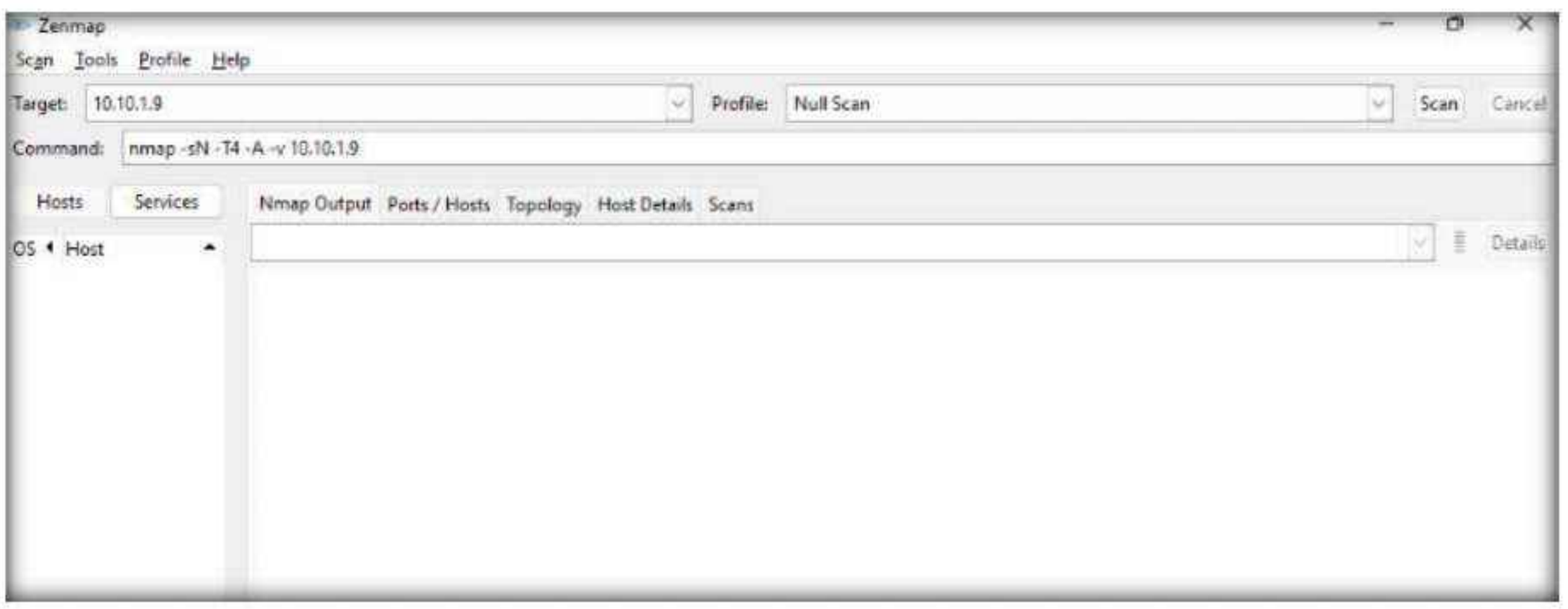


34. Now, click the **Scan** tab and select the scan option (here, **Null scan (-sN)**) from the **TCP scan** drop-down list.
35. Select **None** in the **Non-TCP scans** drop-down list and **Aggressive (-T4)** in the **Timing template** list. Ensure that the **Enable all advanced/aggressive options (-A)** checkbox is selected and click **Save Changes**, as shown in the screenshot.

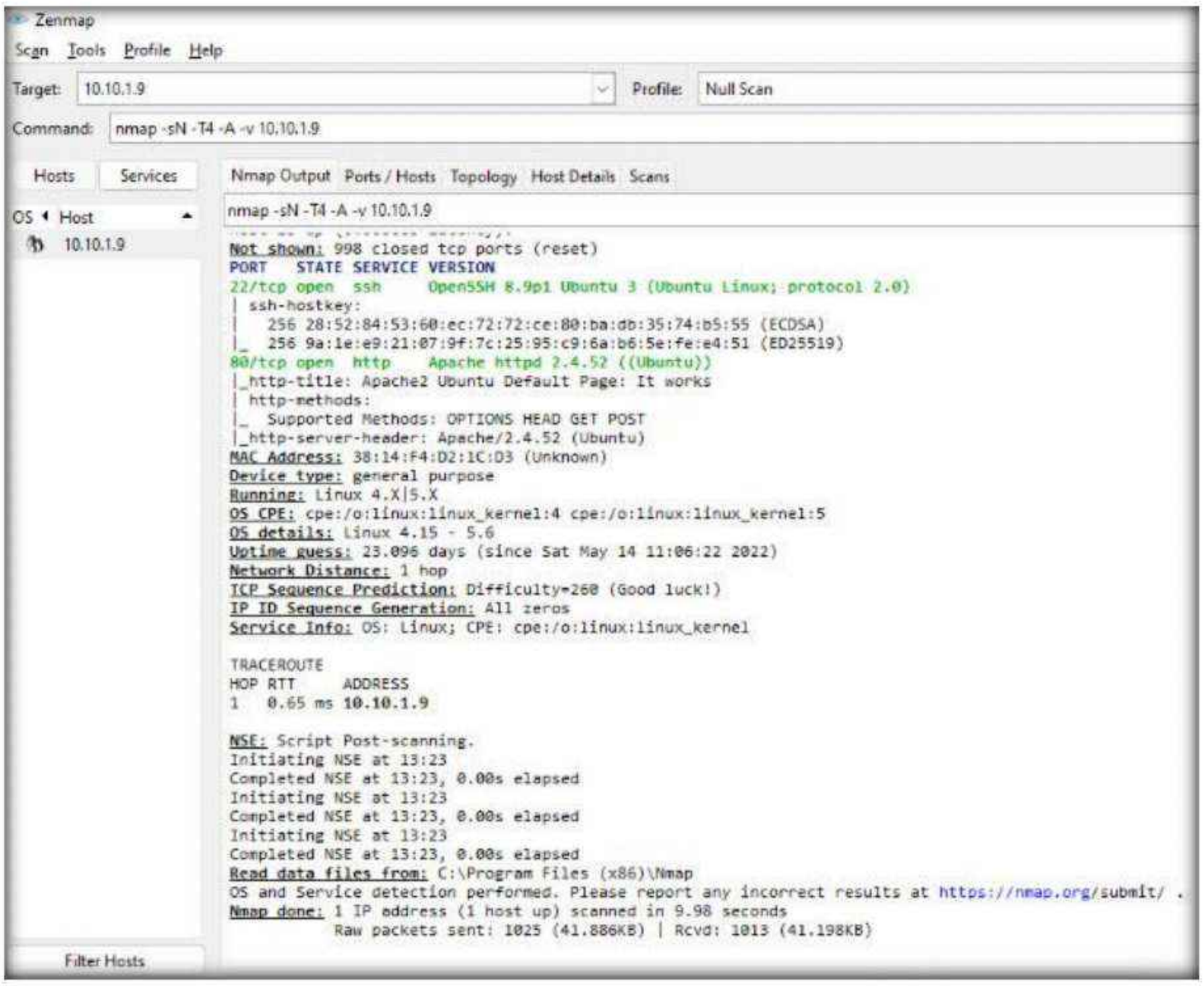
    Note: Using this configuration, you are setting Nmap to perform a null scan with the time template as **-T4** and all **aggressive** options enabled.
36. This will create a new profile, and will thus be added to the profile list.



37. In this sub-task, we will be targeting the **Ubuntu** machine (**10.10.1.9**).
38. In the main window of **Zenmap**, enter the target IP address (here, **10.10.1.9**) in the **Target** field to scan. Select the **Null Scan** profile, which you created from the **Profile** drop-down list, and then click **Scan**.



39. Nmap scans the target and displays results in the **Nmap Output** tab, as shown in the screenshot.



40. Apart from the aforementioned port scanning and service discovery techniques, you can also use the following scanning techniques to perform a port and service discovery on a target network using Nmap.

- **IDLE/IPID Header Scan**: A TCP port scan method that can be used to send a spoofed source address to a computer to discover what services are available.

  nmap -sI -v [target IP address]

- **SCTP INIT Scan**: An INIT chunk is sent to the target host; an INIT+ACK chunk response implies that the port is open, and an ABORT Chunk response means that the port is closed.

  nmap -sY -v [target IP address]

- **SCTP COOKIE ECHO Scan**: A COOKIE ECHO chunk is sent to the target host; no response implies that the port is open and ABORT Chunk response means that the port is closed.

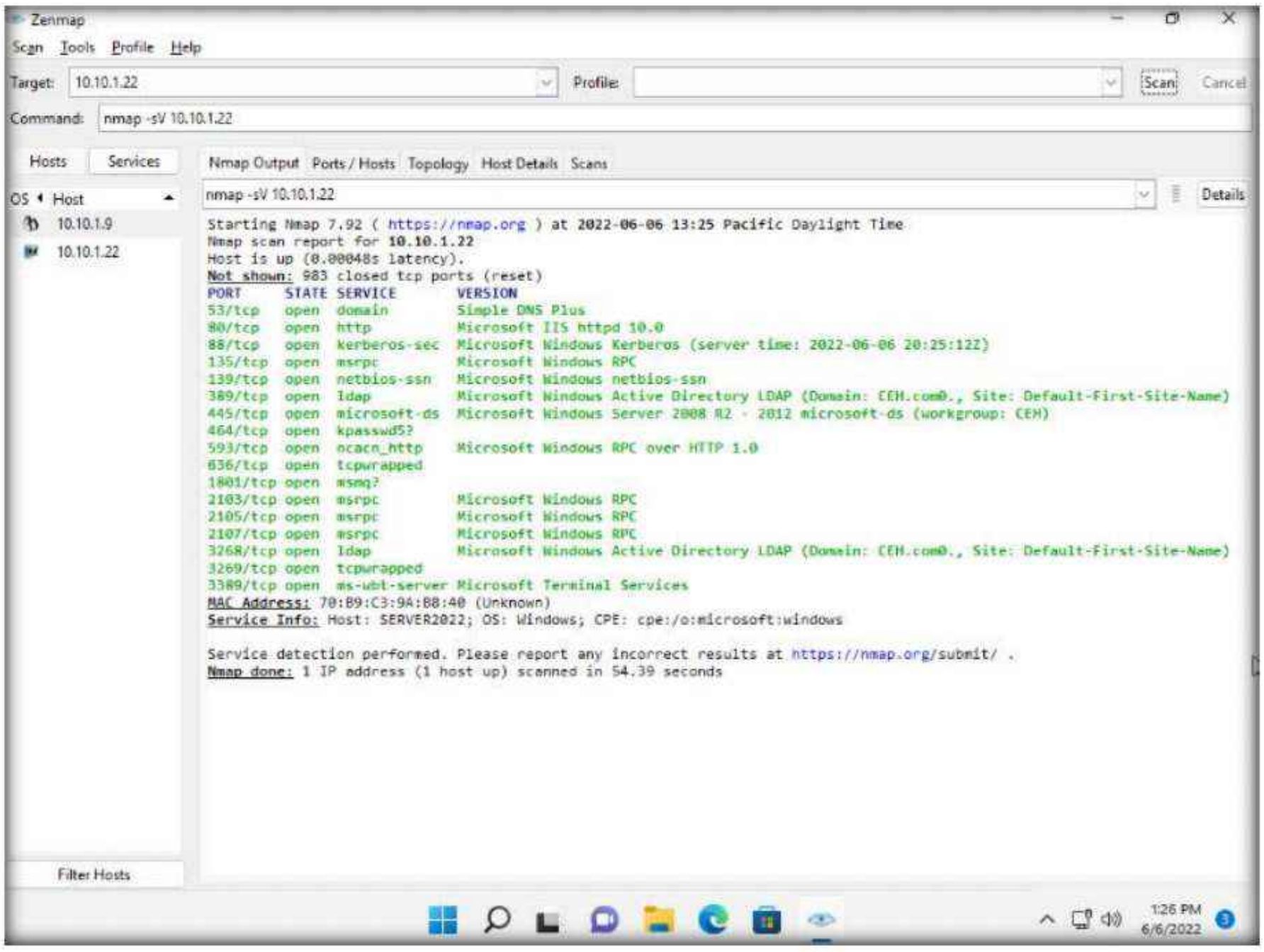
  nmap -sZ -v [target IP address]

41. In the **Command** field, type the command **nmap -sV [Target IP Address]** (here, the target IP address is **10.10.1.22**) and click **Scan**.

    Note: **-sV**: detects service versions.

42. The scan results appear, displaying that open ports and the version of services running on the ports, as shown in the screenshot.

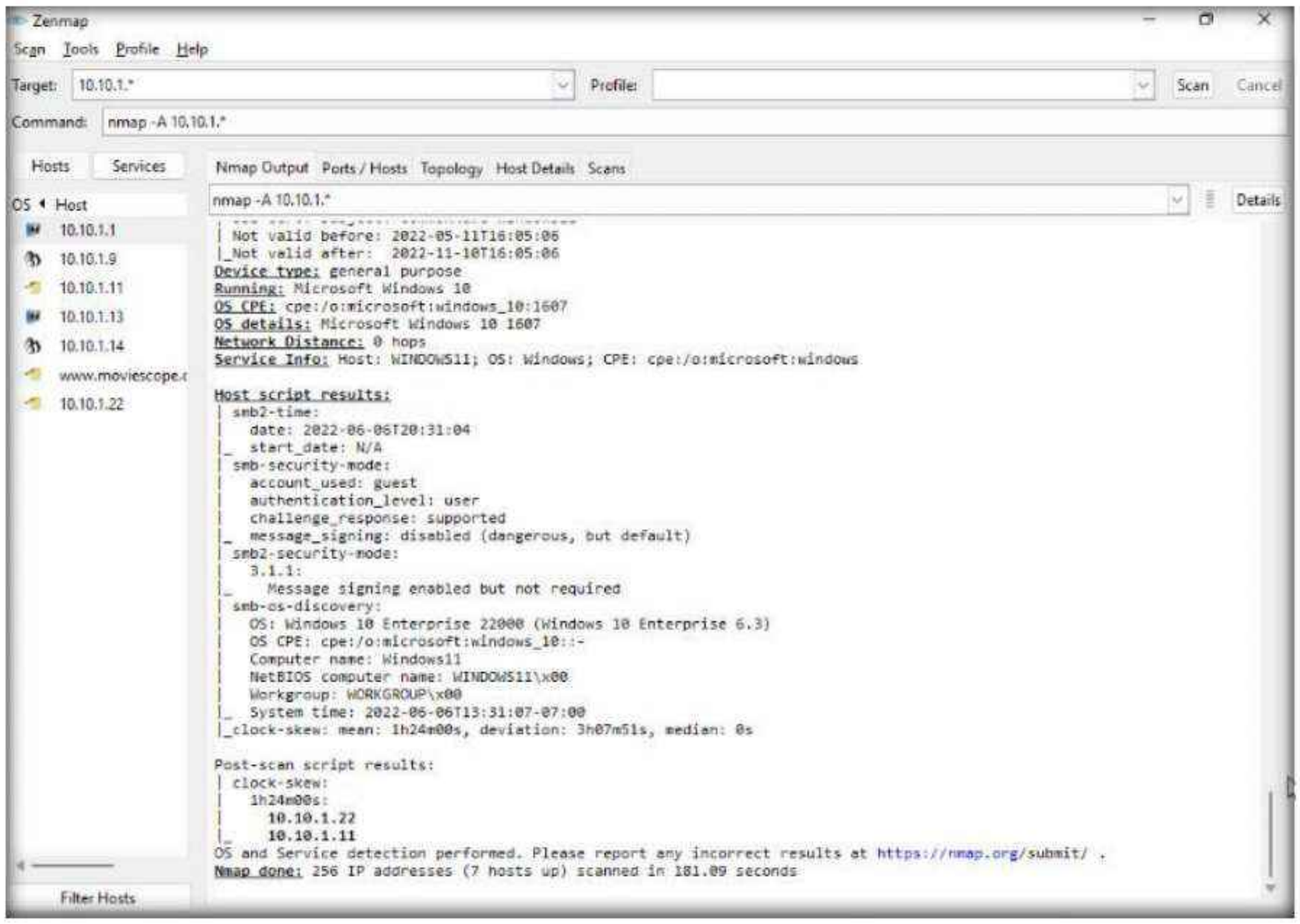
    Note: Service version detection helps you to obtain information about the running services and their versions on a target system. Obtaining an accurate service version number allows you to determine which exploits the target system is vulnerable to.



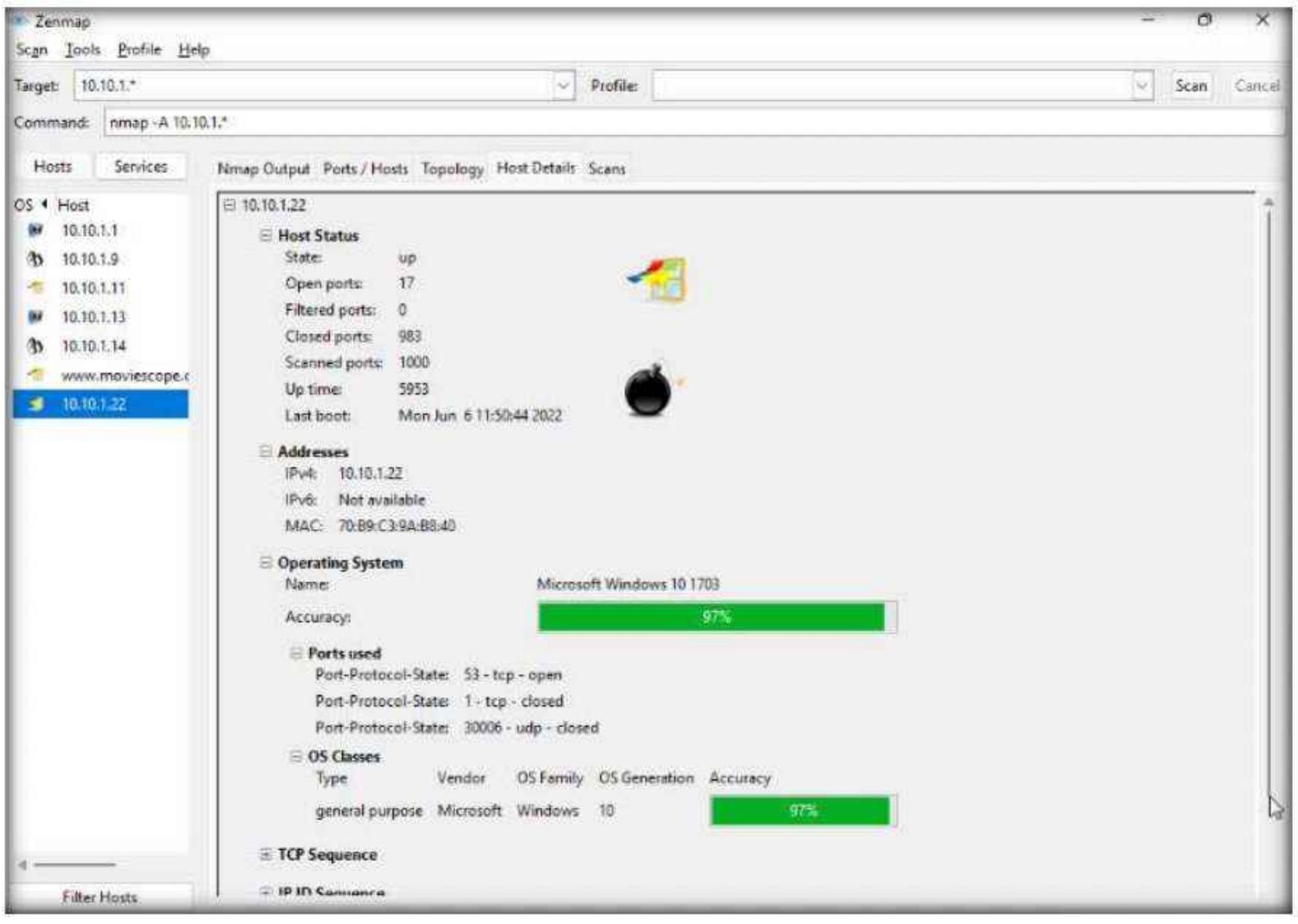
43. In the **Command** field, type the command **nmap -A [Target Subnet]** (here, target subnet is **10.10.1.***) and click **Scan**. By providing the "*" (asterisk) wildcard, you can scan a whole subnet or IP range.

    Note: **-A**: enables aggressive scan. The aggressive scan option supports OS detection (-O), version scanning (-sV), script scanning (-sC), and traceroute (--traceroute). You should not use -A against target networks without permission.

44. Nmap scans the entire network and displays information for all the hosts that were scanned, along with the open ports and services, device type, details of OS, etc. as shown in the screenshot.



45. Choose an IP address **10.10.1.22** from the list of hosts in the left-pane and click the **Host Details** tab. This tab displays information such as **Host Status**, **Addresses**, **Operating System**, **Ports used**, **OS Classes**, etc. associated with the selected host.



46. This concludes the demonstration of discovering target open ports, services, services versions, device type, OS details, etc. of the active hosts in the target network using various scanning techniques of Nmap.
47. Close all open windows and document all the acquired information.
48. Turn off the **Windows 11** and **Ubuntu** virtual machines.

Task 5: Explore Various Network Scanning Techniques using Hping3

Hping2/Hping3 is a command-line-oriented network scanning and packet crafting tool for the TCP/IP protocol that sends ICMP echo requests and supports TCP, UDP, ICMP, and raw-IP protocols. Using Hping, you can study the behavior of an idle host and gain information about the target such as the services that the host offers, the ports supporting the services, and the OS of the target.

Here, we will use Hping3 to discover open ports and services running on the live hosts in the target network.

Note: Ensure that the **Windows Server 2022** virtual machine is running.

1. Turn on the **Parrot Security** virtual machine.
2. In the login page, the **attacker** username will be selected by default. Enter password as **toor** in the **Password** field and press **Enter** to log in to the machine.

   Note: If a **Parrot Updater** pop-up appears at the top-right corner of **Desktop**, ignore and close it.

   Note: If a **Question** pop-up window appears asking you to update the machine, click **No** to close the window.
3. Click the **MATE Terminal** icon at the top of the **Desktop** to open a **Terminal** window.
4. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
5. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

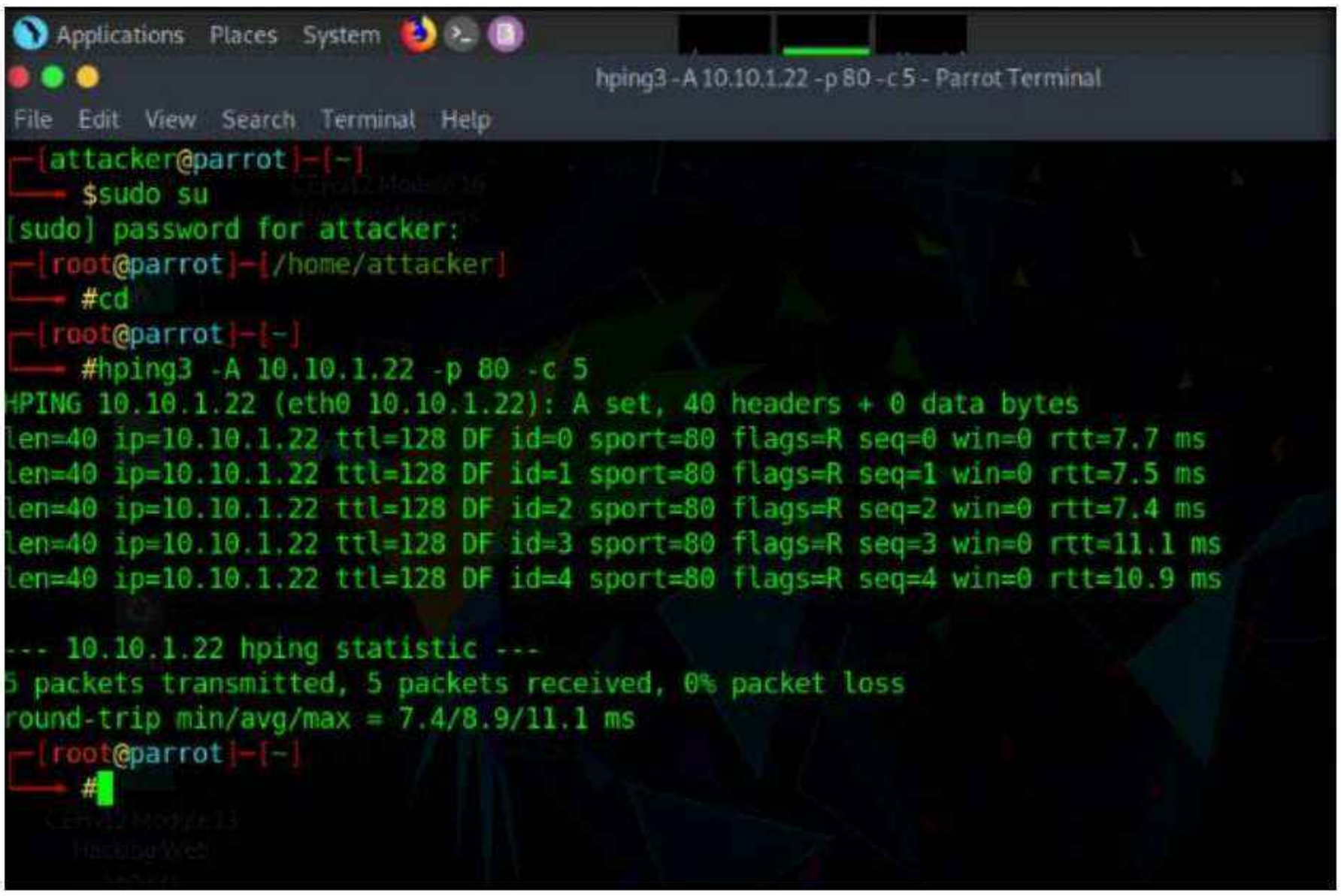
   Note: The password that you type will not be visible.
6. Now, type **cd** and press **Enter** to jump to the root directory.

7. A **Parrot Terminal** window appears. In the terminal window, type **hping3 -A [Target IP Address] -p 80 -c 5** (here, the target machine is **Windows Server 2022** [**10.10.1.22**]) and press **Enter**.

   Note: In this command, **-A** specifies setting the ACK flag, **-p** specifies the port to be scanned (here, **80**), and **-c** specifies the packet count (here, **5**).

8. In a result, the number of packets sent and received is equal, indicating that the respective port is open, as shown in the screenshot.

   Note: The ACK scan sends an ACK probe packet to the target host; no response means that the port is filtered. If an RST response returns, this means that the port is closed.

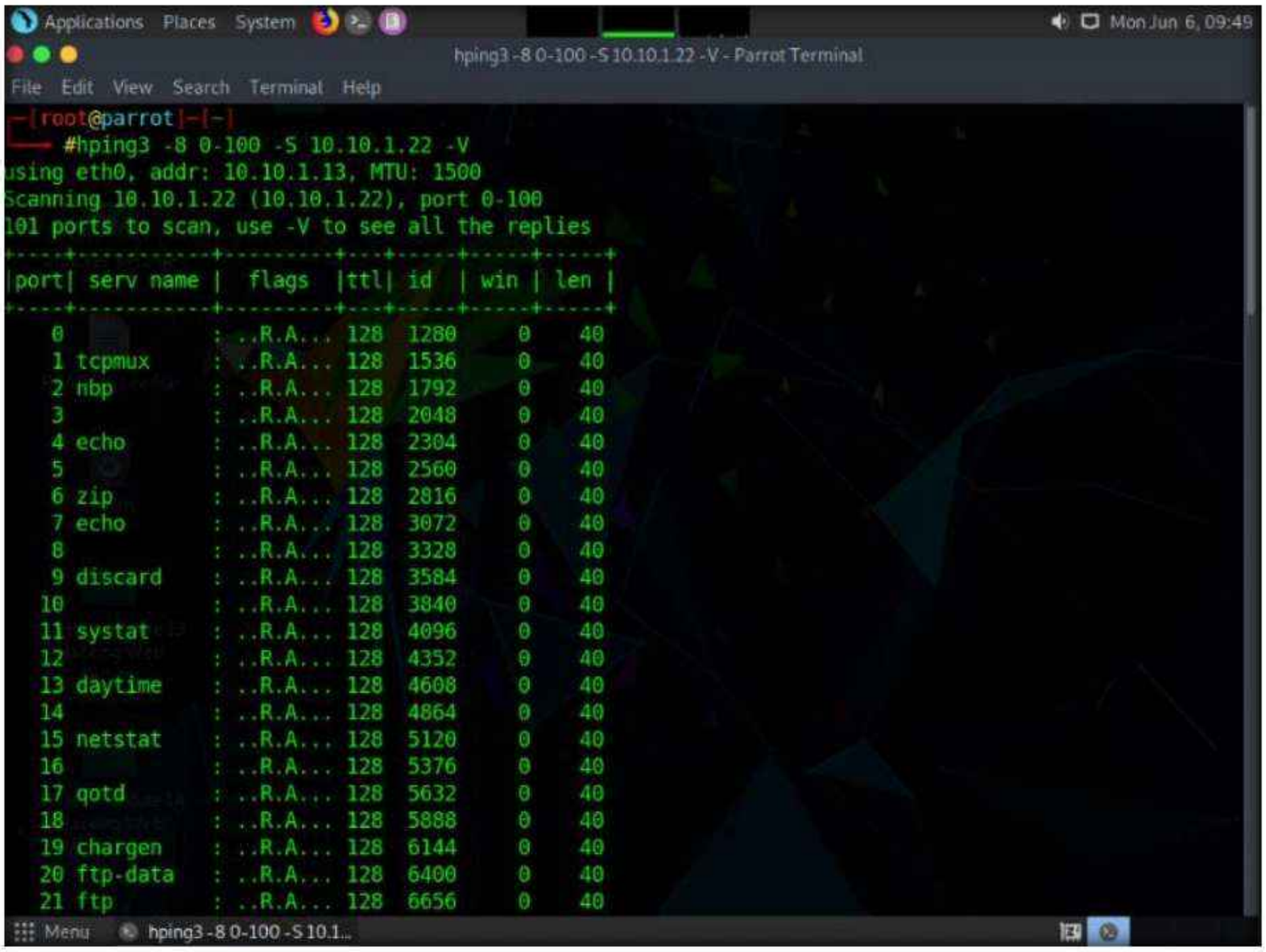


9. In the terminal window, type **hping3 -8 0-100 -S [Target IP Address] -V** (here, the target machine is **Windows Server 2022** [**10.10.1.22**]) and press **Enter**.

   Note: In this command, **-8** specifies a scan mode, **-p** specifies the range of ports to be scanned (here, **0-100**), and **-V** specifies the verbose mode.

10. The result appears, displaying the open ports along with the name of service running on each open port, as shown in the screenshot.

    Note: The SYN scan principally deals with three of the flags: SYN, ACK, and RST. You can use these three flags for gathering illegal information from servers during the enumeration process.



11. In the terminal window, type **hping3 -F -P -U [Target IP Address] -p 80 -c 5** (here, the target machine is **Windows Server 2022** [**10.10.1.22**]) and press **Enter**.

    Note: In this command, **-F** specifies setting the FIN flag, **-P** specifies setting the PUSH flag, **-U** specifies setting the URG flag, **-c** specifies the packet count (here, **5**), and **-p** specifies the port to be scanned (here, **80**).

12. The results demonstrate that the number of packets sent and received is equal, thereby indicating that the respective port is open, as shown in the screenshot.

    Note: FIN, PUSH, and URG scan the port on the target IP address. If a port is open on the target, you will receive a response. If the port is closed, Hping will return an RST response.

13. In the terminal window, type **hping3 --scan 0-100 -S [Target IP Address]** (here, the target machine is **Windows Server 2022** [**10.10.1.22**]) and press **Enter**.

    Note: In this command, **--scan** specifies the port range to scan, **0-100** specifies the range of ports to be scanned, and **-S** specifies setting the SYN flag.

14. The result appears displaying the open ports and names of the services running on the target IP address, as shown in the screenshot.

    Note: In the TCP stealth scan, the TCP packets are sent to the target host; if a SYN+ACK response is received, it indicates that the ports are open.

```
┌─[root@parrot]─[~]
└──╼ #hping3 --scan 0-100 -S 10.10.1.22
Scanning 10.10.1.22 (10.10.1.22), port 0-100
101 ports to scan, use -V to see all the replies
+----+-----------+---------+---+-----+-----+-----+
|port| serv name |  flags  |ttl| id  | win | len |
+----+-----------+---------+---+-----+-----+-----+
   53 domain    : .S..A... 128  7663 65392    44
   80 http      : .S..A... 128 14575 65392    44
   88 kerberos  : .S..A... 128 16623 65392    44
All replies received. Done.
Not responding ports:
```

15. In the **terminal** window, type **hping3 -1 [Target IP Address] -p 80 -c 5** to perform ICMP scan (here, the target machine is **Windows Server 2022** [**10.10.1.22**]) and press **Enter**

    Note: In this command, **-1** specifies ICMP ping scan, **-c** specifies the packet count (here, **5**), and **-p** specifies the port to be scanned (here, **80**).

16. The results demonstrate that hping has sent ICMP echo requests to 10.10.1.22 and received ICMP replies which determines that the host is up.

```
Applications  Places  System
hping3 -1 10.10.1.22 -p 80 -c 5 - Parrot Terminal
File  Edit  View  Search  Terminal  Help
┌─[root@parrot]─[~]
└──╼ #hping3 -1 10.10.1.22 -p 80 -c 5
HPING 10.10.1.22 (eth0 10.10.1.22): icmp mode set, 28 headers + 0 data bytes
len=28 ip=10.10.1.22 ttl=128 id=61440 icmp_seq=0 rtt=7.8 ms
len=28 ip=10.10.1.22 ttl=128 id=61441 icmp_seq=1 rtt=7.7 ms
len=28 ip=10.10.1.22 ttl=128 id=61442 icmp_seq=2 rtt=7.5 ms
len=28 ip=10.10.1.22 ttl=128 id=61443 icmp_seq=3 rtt=3.2 ms
len=28 ip=10.10.1.22 ttl=128 id=61444 icmp_seq=4 rtt=7.1 ms

--- 10.10.1.22 hping statistic ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 3.2/6.6/7.8 ms
┌─[root@parrot]─[~]
└──╼ #
```

17. Apart from the aforementioned port scanning and service discovery techniques, you can also use the following scanning techniques to perform a port and service discovery on a target network using Hping3.
    - Entire subnet scan for live host: **hping3 -1 [Target Subnet] --rand-dest -I eth0**
    - UDP scan: **hping3 -2 [Target IP Address] -p 80 -c 5**
18. This concludes the demonstration of discovering open ports and services running on the live hosts in the target network using Hping3.
19. Close all open windows and document all the acquired information.
20. Turn off the **Parrot Security** and **Windows Server 2022** virtual machines.

Lab Analysis

Analyze and document the results of this lab exercise.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Internet Connection Required	
☐ Yes	☑ No
Platform Supported	
☑ Classroom	☑ CyberQ

Lab 3

Perform OS Discovery

Banner grabbing, or OS fingerprinting, is used to determine the OS running on a remote target system.

Lab Scenario

As a professional ethical hacker or a pen tester, the next step after discovering the open ports and services running on the target range of IP addresses is to perform OS discovery. Identifying the OS used on the target system allows you to assess the system's vulnerabilities and the exploits that might work on the system to perform additional attacks.

Lab Objectives

- Identify the target system's OS with Time-to-Live (TTL) and TCP window sizes using Wireshark
- Perform OS discovery using Nmap Script Engine (NSE)
- Perform OS discovery using Unicornscan

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2022 virtual machine
- Parrot Security virtual machine
- Ubuntu virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 15 Minutes

Overview of OS Discovery/ Banner Grabbing

Banner grabbing, or OS fingerprinting, is a method used to determine the OS that is running on a remote target system.

There are two types of OS discovery or banner grabbing techniques:

- **Active Banner Grabbing**: Specially crafted packets are sent to the remote OS, and the responses are noted, which are then compared with a database to determine the OS. Responses from different OSes vary, because of differences in the TCP/IP stack implementation.
- **Passive Banner Grabbing**: This depends on the differential implementation of the stack and the various ways an OS responds to packets. Passive banner grabbing includes banner grabbing from error messages, sniffing the network traffic, and banner grabbing from page extensions.

Parameters such as TTL and TCP window size in the IP header of the first packet in a TCP session plays an important role in identifying the OS running on the target machine. The TTL field determines the maximum time a packet can remain in a network, and the TCP window size determines the length of the packet reported. These values differ for different OSes: you can refer to the following table to learn the TTL values and TCP window size associated with various OSes.

Operating System	Time To Live	TCP Window Size
Linux	64	5840
FreeBSD	64	65535
OpenBSD	255	16384
Windows	128	65,535 bytes to 1 Gigabyte
Cisco Routers	255	4128
Solaris	255	8760
AIX	255	16384

Lab Tasks

Task 1: Identify the Target System's OS with Time-to-Live (TTL) and TCP Window Sizes using Wireshark

Wireshark is a network protocol analyzer that allows capturing and interactively browsing the traffic running on a computer network. It is used to identify the target OS through sniffing/capturing the response generated from the target machine to the request-originated machine. Further, you can observe the TTL and TCP window size fields in the captured TCP packet. Using these values, the target OS can be determined.

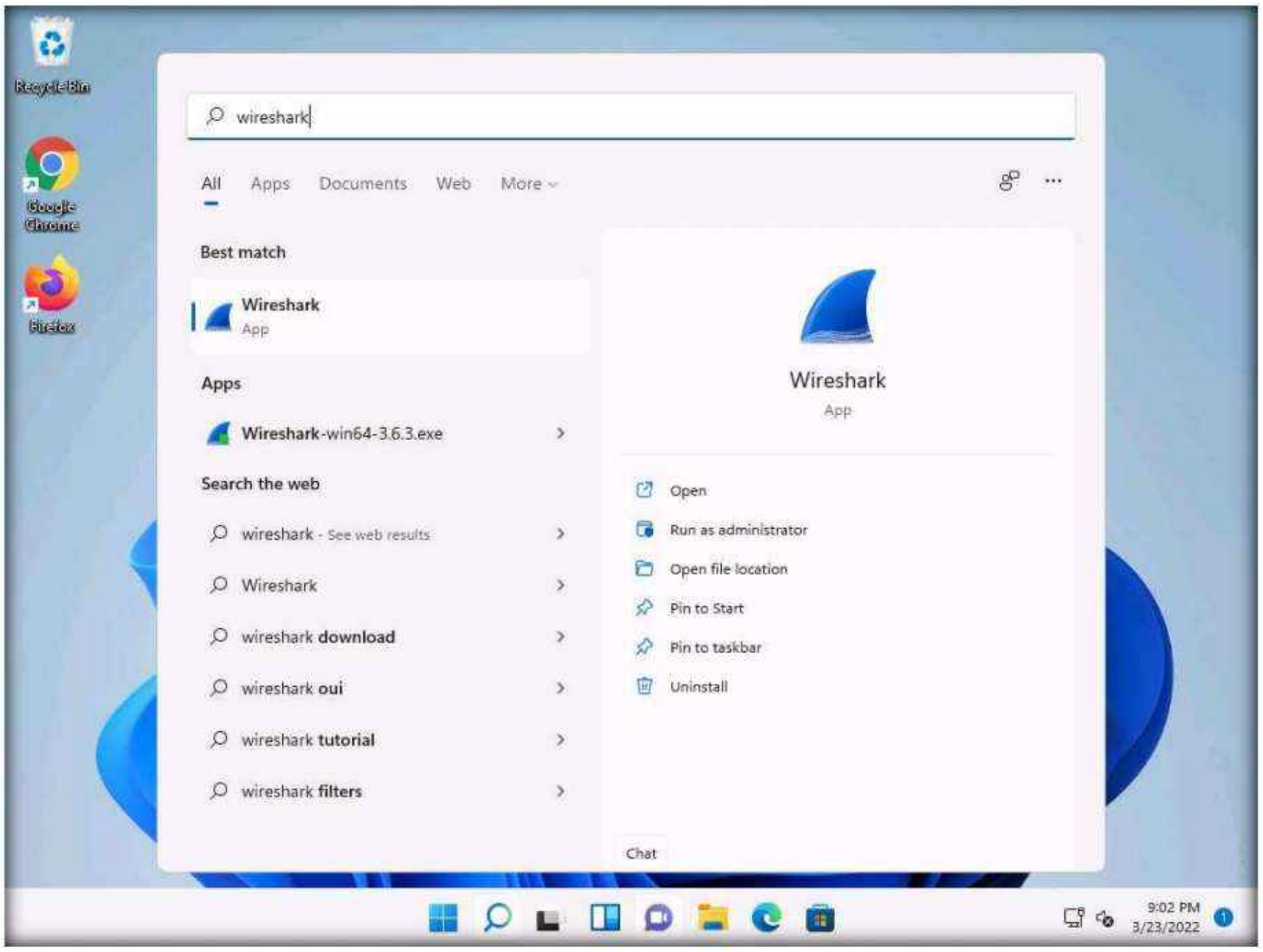
Here, we will use the Wireshark tool to perform OS discovery on the target host(s).

1. Turn on the **Windows 11**, **Windows Server 2022** and **Ubuntu** virtual machines.
2. Switch to the **Windows 11** virtual machine. By default, **Admin** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.

   Note: If **Welcome to Windows** wizard appears, click **Continue** and in **Sign in with Microsoft** wizard, click **Cancel**.

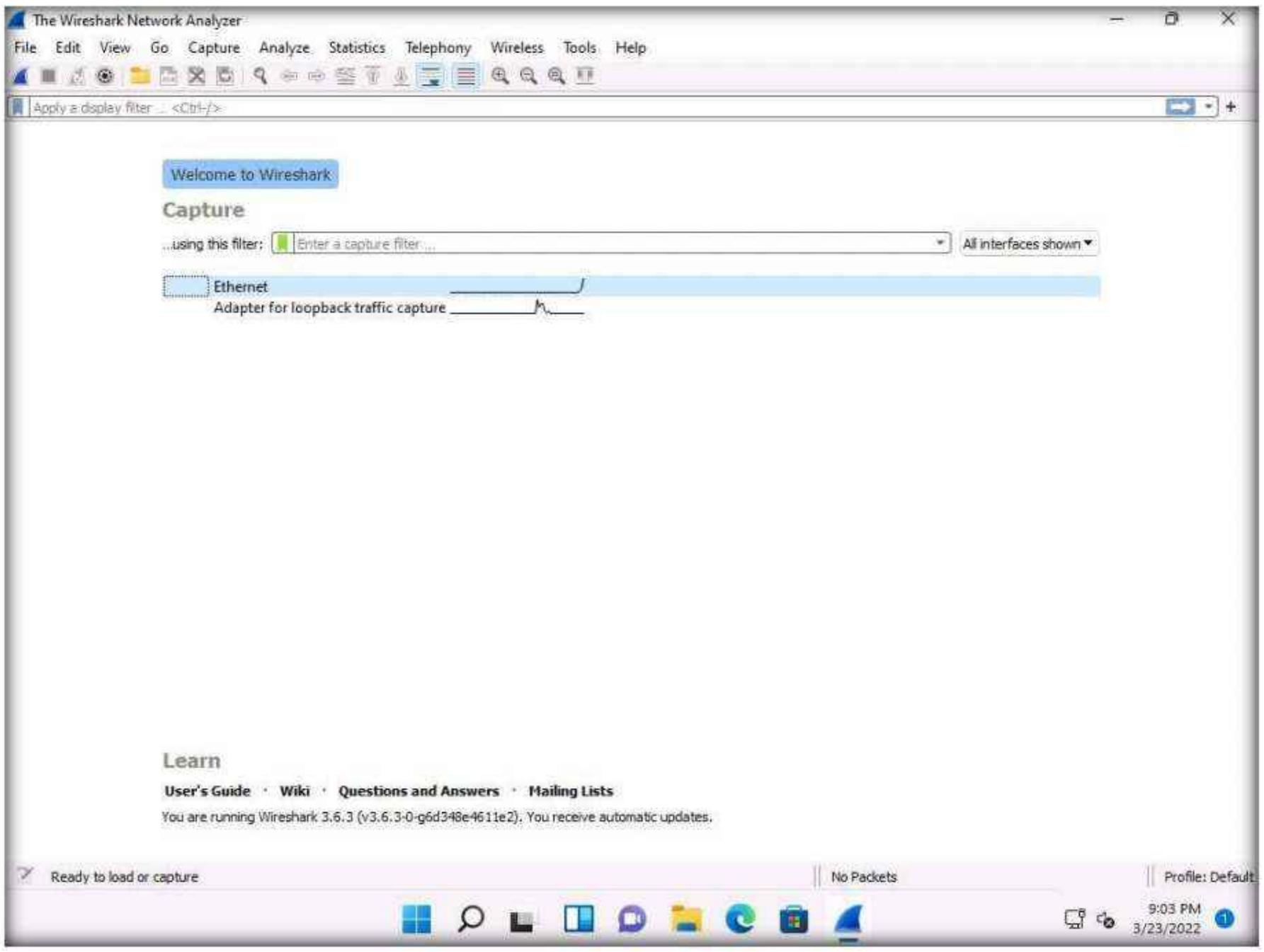
   Note: Networks screen appears, click **Yes** to allow your PC to be discoverable by other PCs and devices on the network.

3. Click **Search** icon () on the **Desktop**. Type **wireshark** in the search field, the **Wireshark** appears in the results, click **Open** to launch it.



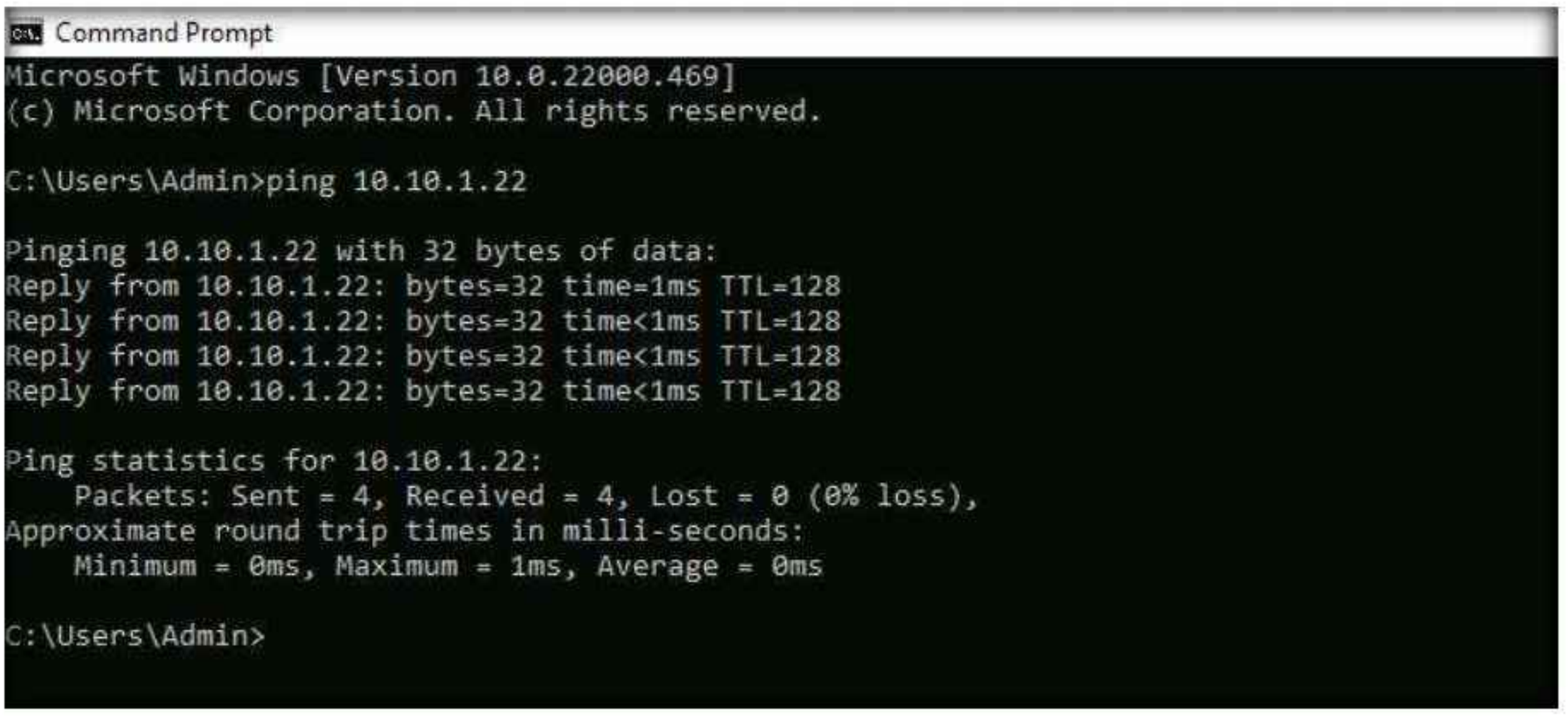
4. The **Wireshark Network Analyzer** main window appears; double-click the available ethernet or interface (here, **Ethernet**) to start the packet capture, as shown in the screenshot.

   Note: If **Software Update** window appears, click **Remind me later**.

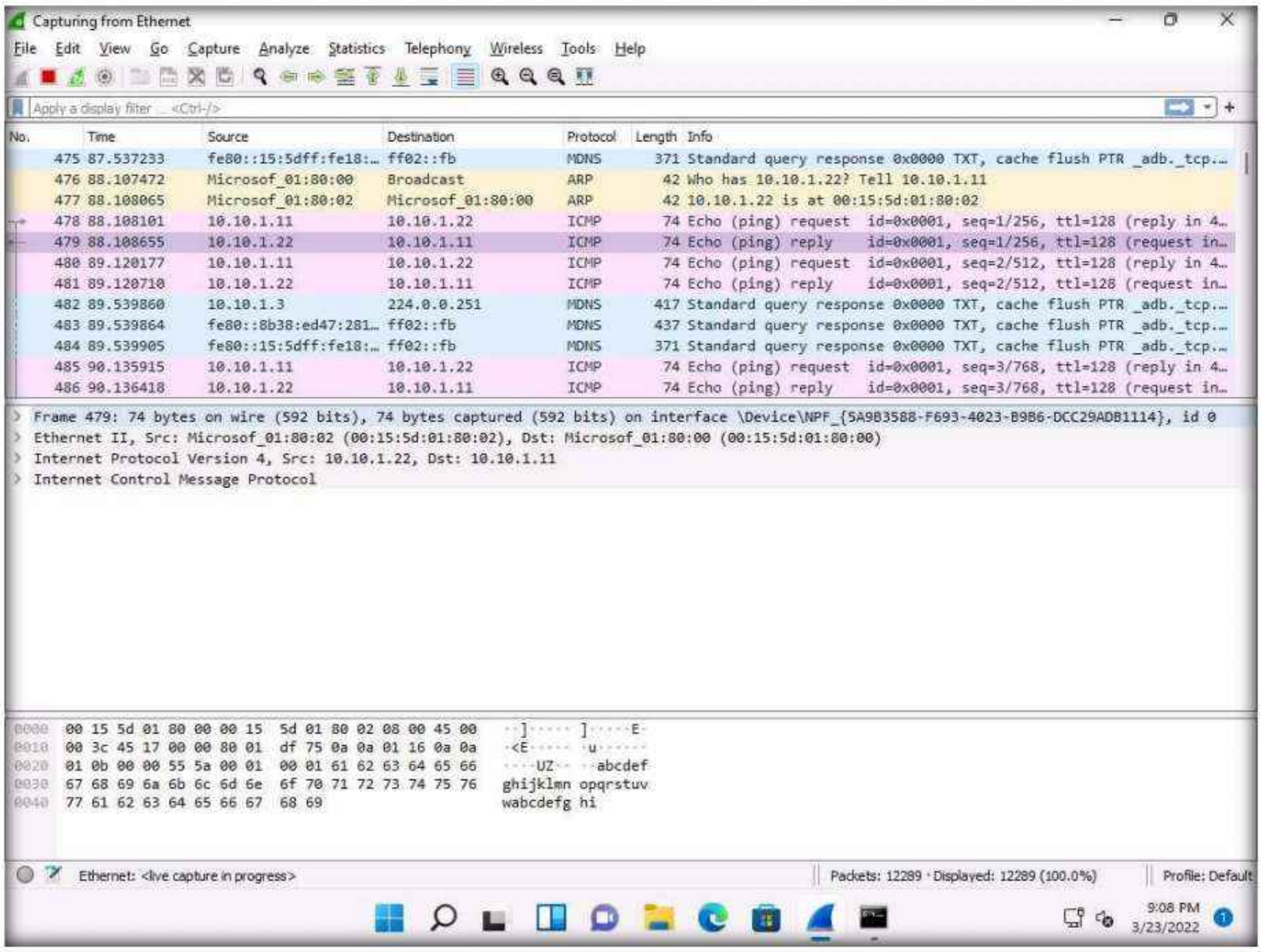


5. Open the **Command Prompt**, type **ping 10.10.1.22** and press **Enter**.

   Note: **10.10.1.22** is the IP address of the **Windows Server 2022** machine.

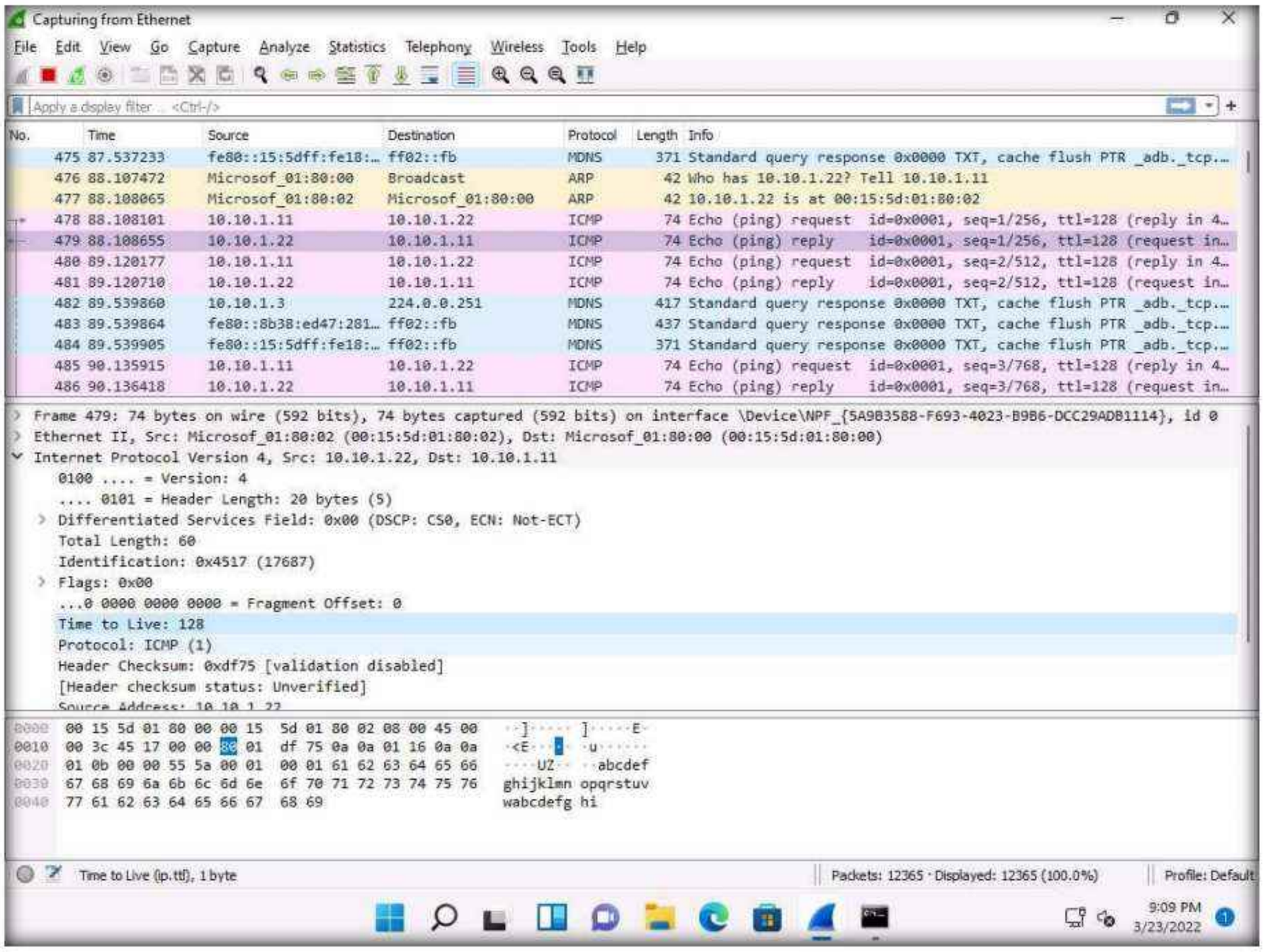


6. Observe the packets captured by **Wireshark**.

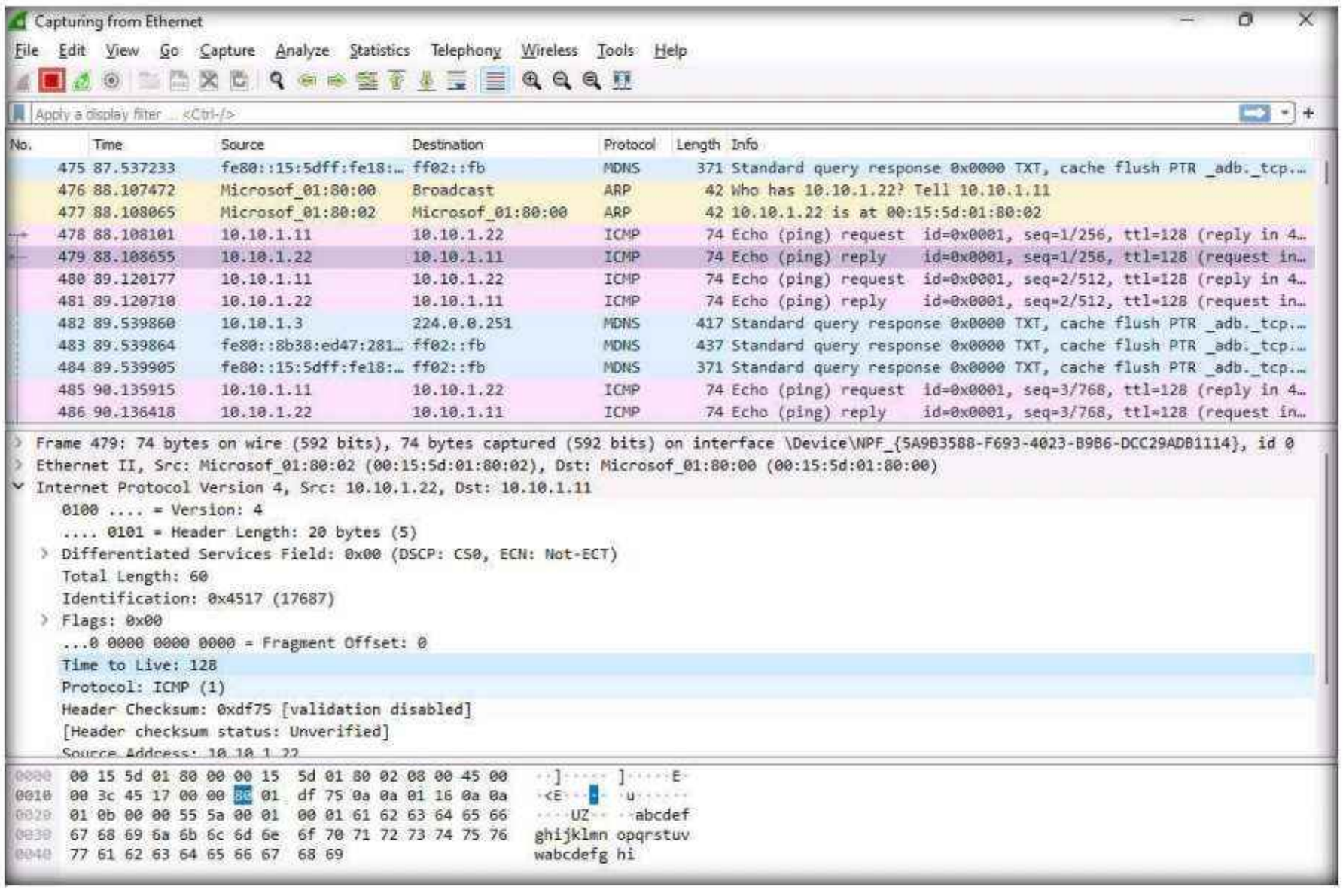


7. Choose any packet of the ICMP reply from the **Windows Server 2022** (**10.10.1.22**) to **Windows 11** (**10.10.1.11**) machines and expand the **Internet Protocol Version 4** node in the **Packet Details** pane.

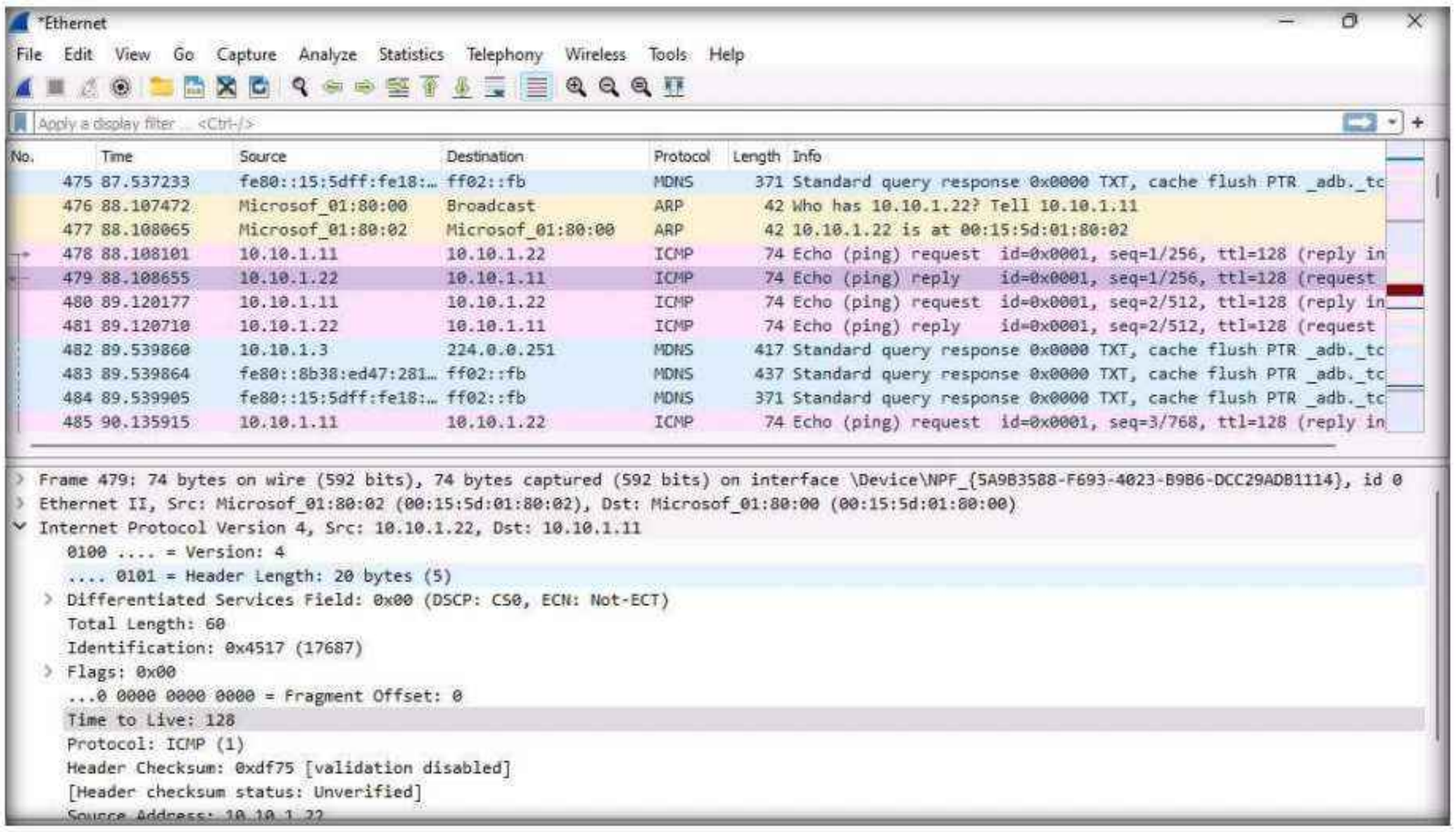
8. The TTL value is recorded as **128**, which means that the ICMP reply possibly came from a Windows-based machine.



9. Now, stop the capture in the **Wireshark** window by clicking on the **Stop** button from the toolbar.

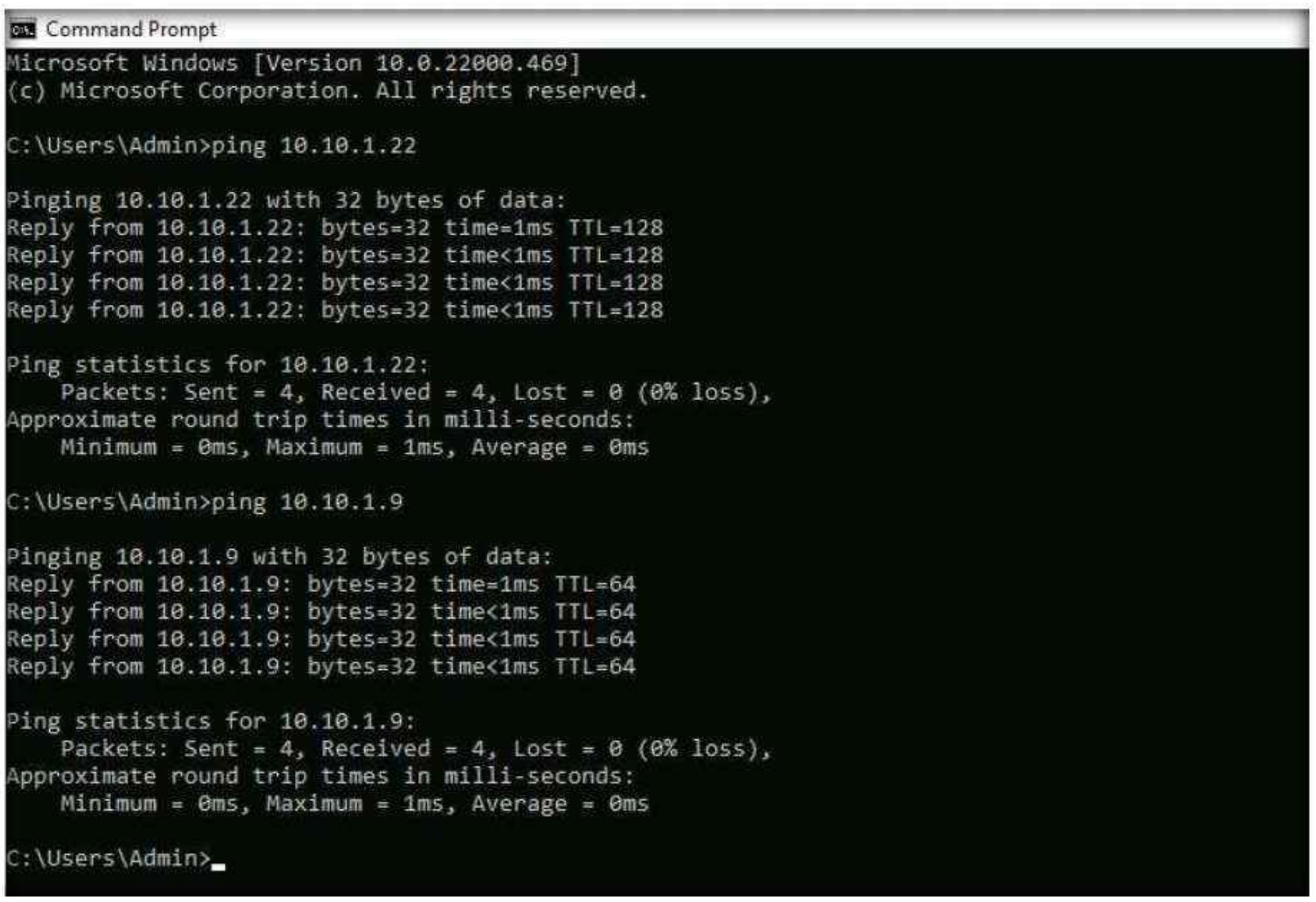


10. Now, click the **Start capturing packets** button from the toolbar. If an **Unsaved packets…** pop-up appears, click **Continue without Saving**.

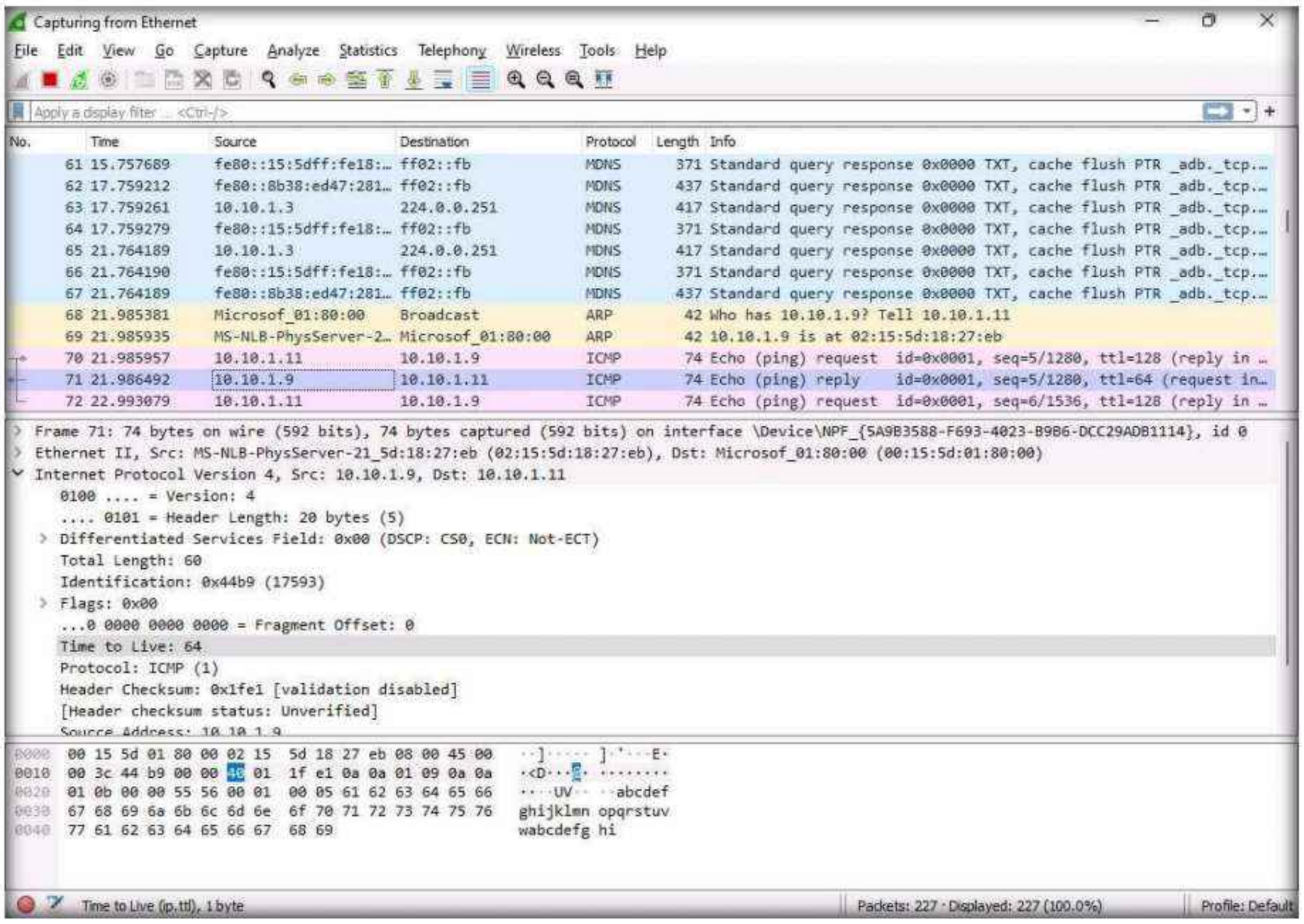


11. Wireshark will start capturing the new packets.
12. In the **Command Prompt** window, type **ping 10.10.1.9** and press **Enter**.

    Note: **10.10.1.9** is the IP address of the **Ubuntu** machine.



13. Observe the packets captured by **Wireshark**.
14. Choose any packet of ICMP reply from the **Ubuntu** (**10.10.1.9**) to **Windows 11** (**10.10.1.11**) machine and expand the **Internet Protocol Version 4** node in the **Packet Details** pane.
15. The TTL value is recorded as **64**, which means the ICMP reply possibly came from a Linux-based machine.



16. Stop the capture in the **Wireshark** window by clicking on the Stop button.
17. This concludes the demonstration of identifying the OS of the target system using Wireshark.
18. Close all open windows and document all the acquired information.
19. Turn off the **Windows 11** and **Ubuntu** virtual machines.

Task 2: Perform OS Discovery using Nmap Script Engine (NSE)

Nmap, along with Nmap Script Engine (NSE), can extract considerable valuable information from the target system. In addition to Nmap commands, NSE provides scripts that reveal all sorts of useful information from the target system. Using NSE, you may obtain information such as OS, computer name, domain name, forest name, NetBIOS computer name, NetBIOS domain name, workgroup, system time of a target system, etc.

Here, we will use Nmap to perform OS discovery using -A parameter, -O parameter, and NSE.

Note: Ensure that the **Windows Server 2022** virtual machine is running.

1. Turn on the **Parrot Security** virtual machine.
2. In the login page, the **attacker** username will be selected by default. Enter password as **toor** in the **Password** field and press **Enter** to log in to the machine.

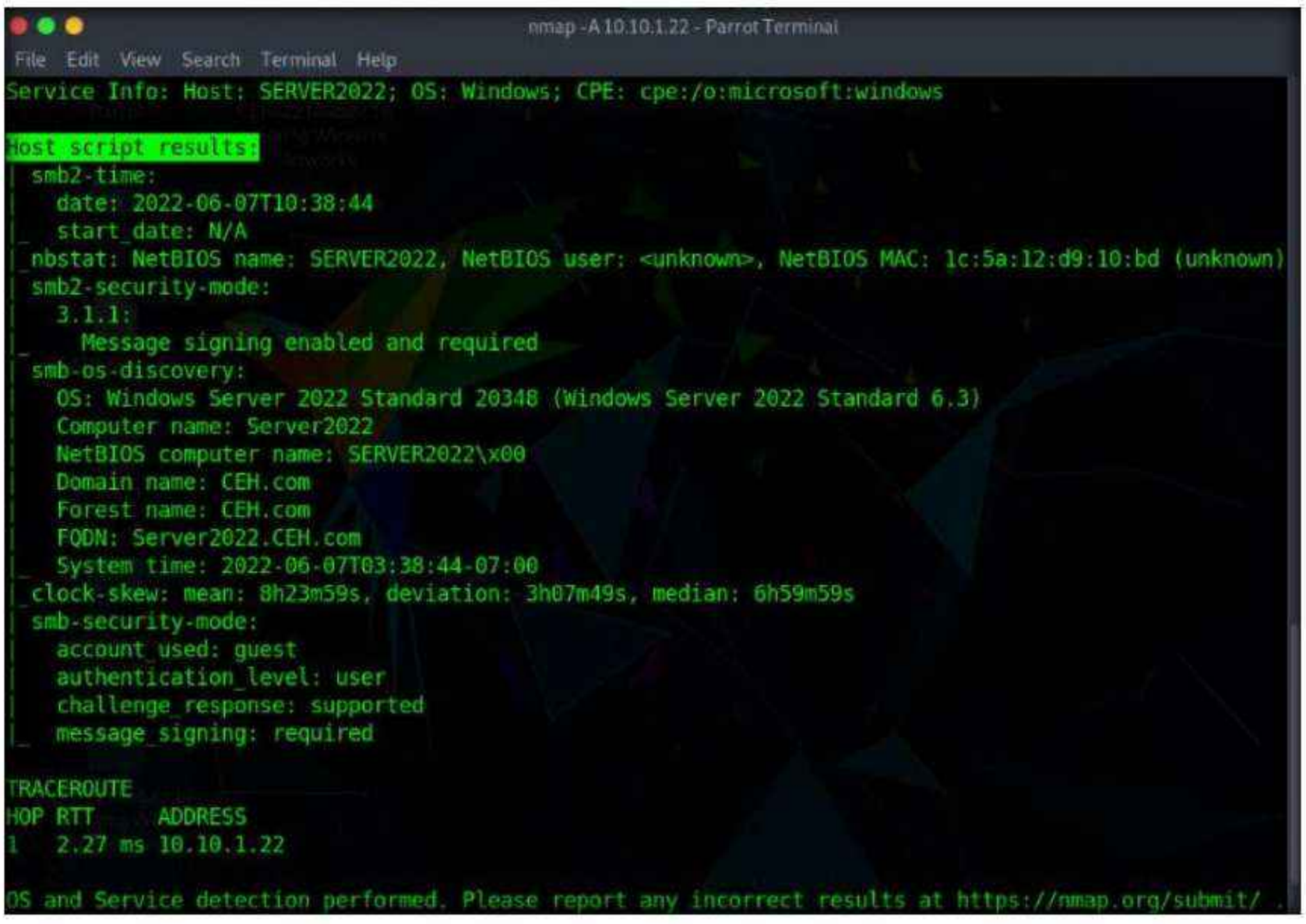
   Note: If a **Parrot Updater** pop-up appears at the top-right corner of **Desktop**, ignore and close it.

   Note: If a **Question** pop-up window appears asking you to update the machine, click **No** to close the window.
3. Click the **MATE Terminal** icon at the top of the **Desktop** to open a **Terminal** window.
4. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
5. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.
6. In the terminal window, type the command **nmap -A [Target IP Address]** (here, the target machine is **Windows Server 2022** [**10.10.1.22**]) and press **Enter**.

   Note: **-A**: to perform an aggressive scan.

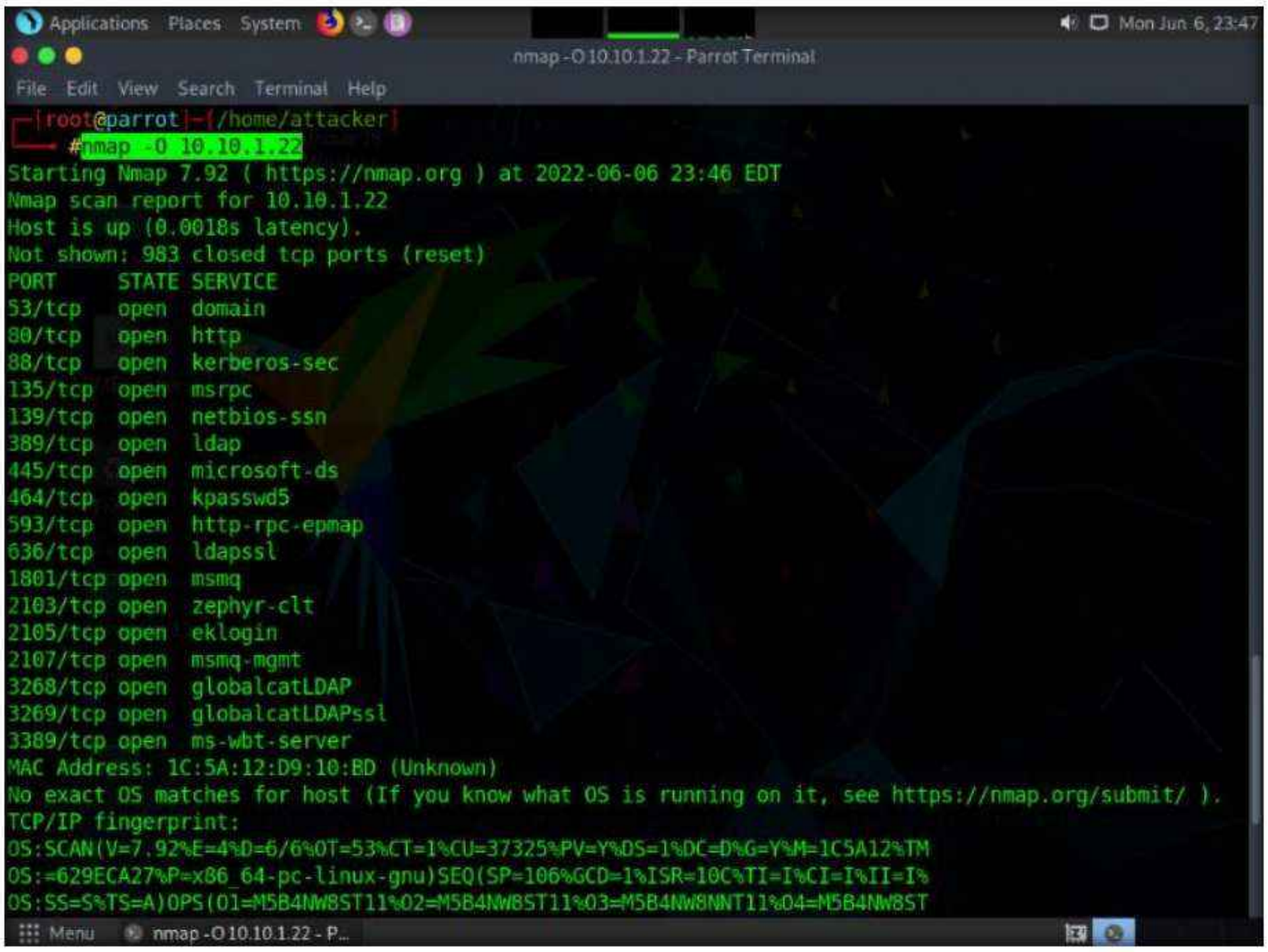
   Note: The scan takes approximately 10 minutes to complete.
7. The scan results appear, displaying the open ports and running services along with their versions and target details such as OS, computer name, NetBIOS computer name, etc. under the **Host script results** section.



8. In the terminal window, type the command **nmap -O [Target IP Address]** (here, the target machine is **Windows Server 2022** [**10.10.1.22**]) and press **Enter**.

   Note: **-O**: performs the OS discovery.

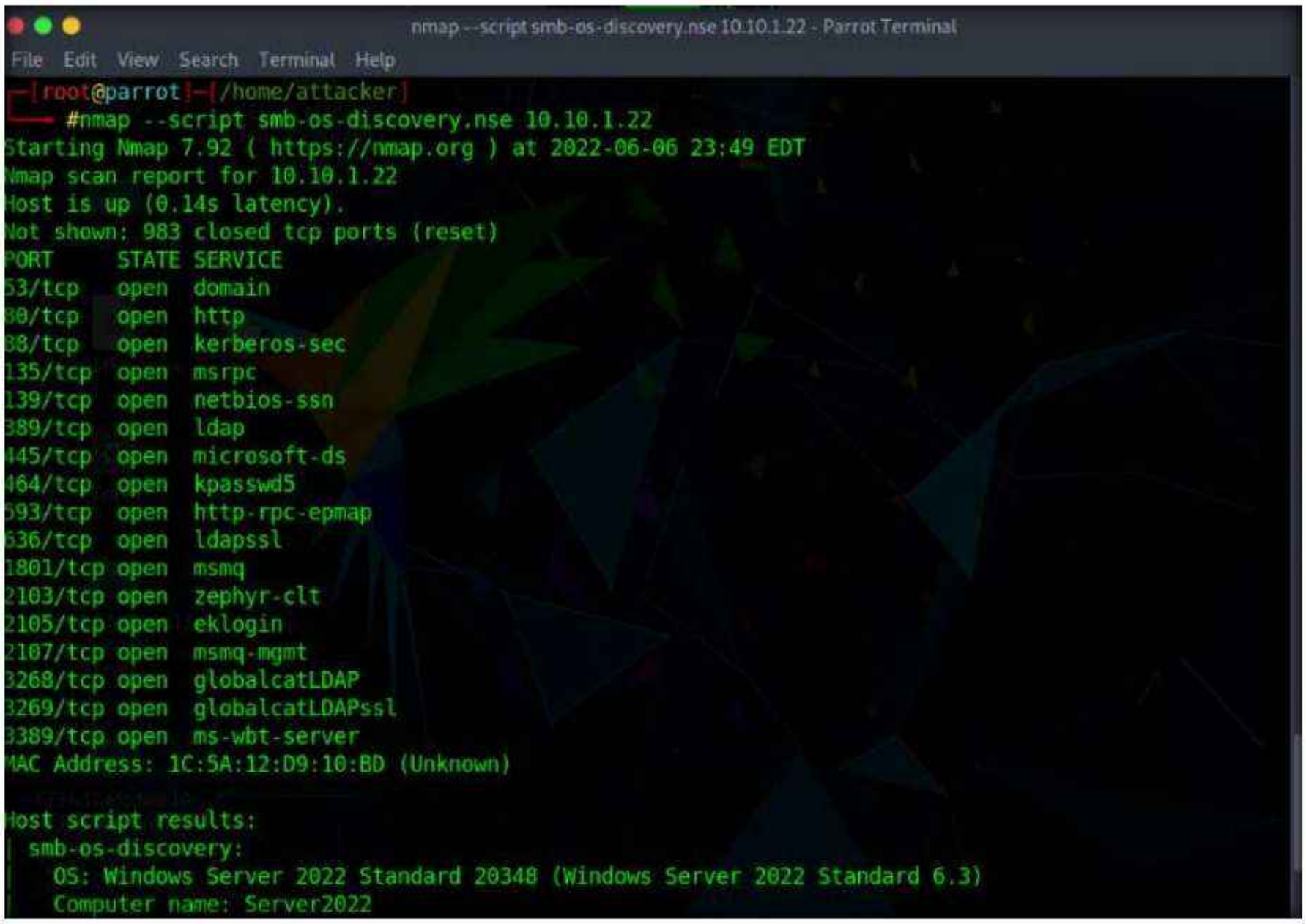
9. The scan results appear, displaying information about open ports, respective services running on the open ports, and the name of the OS running on the target system.

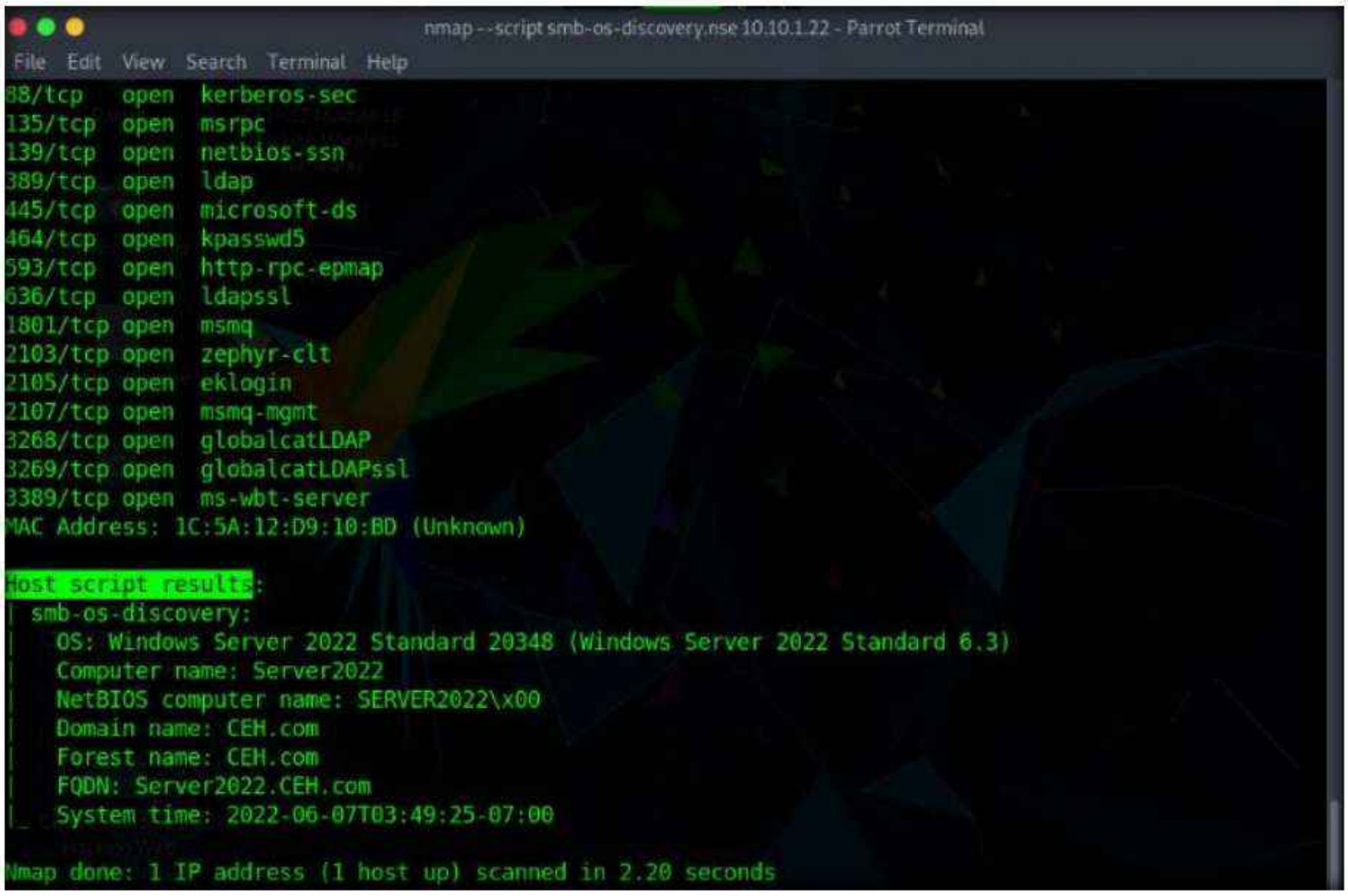


10. In the terminal window, type the command **nmap --script smb-os-discovery.nse [Target IP Address]** (here, the target machine is **Windows Server 2022** [**10.10.1.22**]) and press **Enter**.

    Note: **--script**: specifies the customized script and **smb-os-discovery.nse**: attempts to determine the OS, computer name, domain, workgroup, and current time over the SMB protocol (ports 445 or 139).

11. The scan results appear, displaying the target OS, computer name, NetBIOS computer name, etc. details under the **Host script results** section.





12. This concludes the demonstration of discovering the OS running on the target system using Nmap.
13. Close all open windows and document all the acquired information.

Task 3: Perform OS Discovery using Unicornscan

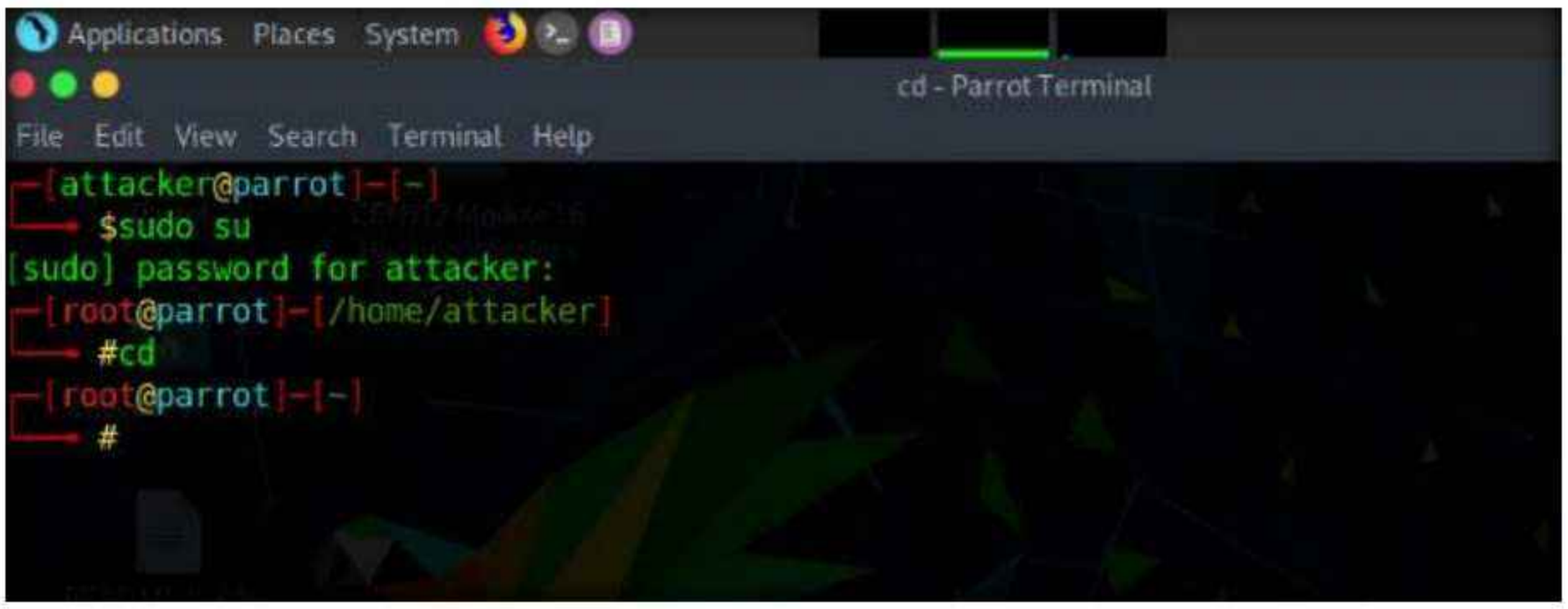
Unicornscan is a Linux-based command line-oriented network information-gathering and reconnaissance tool. It is an asynchronous TCP and UDP port scanner and banner grabber that enables you to discover open ports, services, TTL values, etc. running on the target machine. In Unicornscan, the OS of the target machine can be identified by observing the TTL values in the acquired scan result.

Here, we will use the Unicornscan tool to perform OS discovery on the target system.

Note: Ensure that the **Windows Server 2022** virtual machine is running.

1. Turn on the **Ubuntu** virtual machine.
2. Switch to the **Parrot Security** virtual machine and click the **MATE Terminal** icon at the top of the **Desktop** to open a **Terminal** window.
3. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
4. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

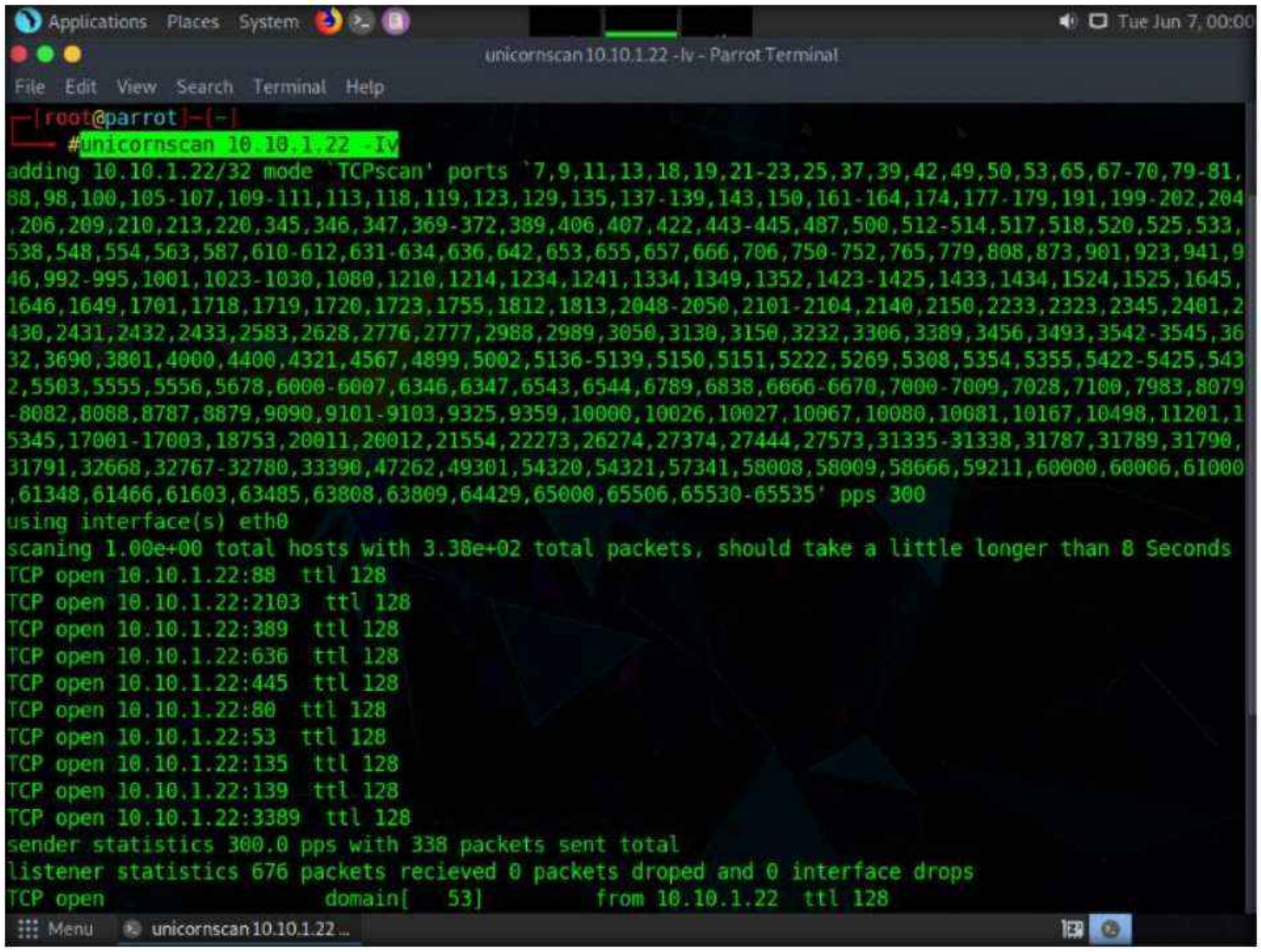
   Note: The password that you type will not be visible.
5. Now, type **cd** and press **Enter** to jump to the root directory.



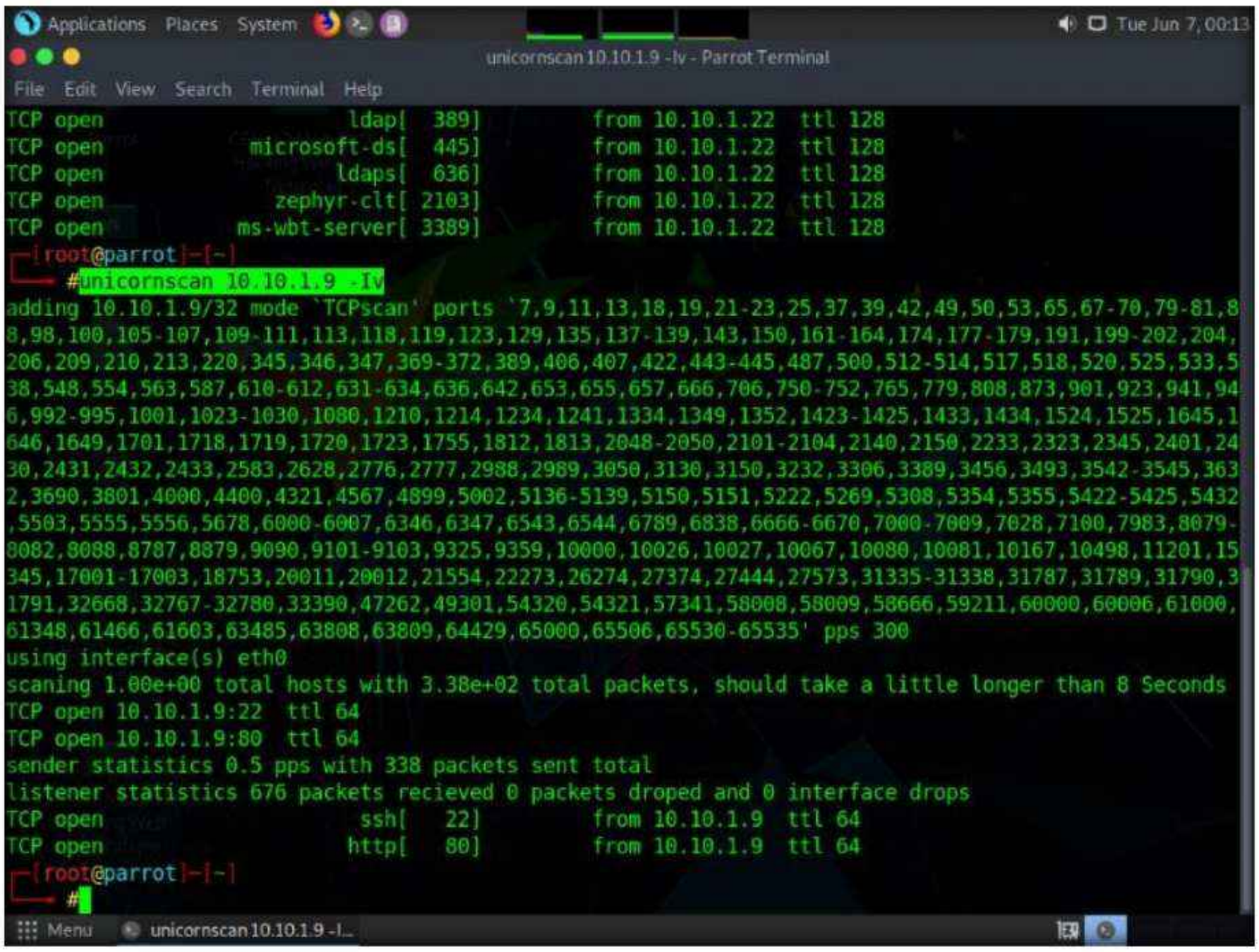
6. In the terminal window, type **unicornscan [Target IP Address] -Iv** (here, the target machine is **Windows Server 2022** [**10.10.1.22**]) and press **Enter**.

   Note: In this command, **-I** specifies an immediate mode and **v** specifies a verbose mode.
7. The scan results appear, displaying the open TCP ports along with the obtained TTL value of **128**. As shown in the screenshot, the **ttl** values acquired after the scan are **128**; hence, the OS is possibly Microsoft Windows (Windows 8/8.1/10/11 or Windows Server 16/19/22).

   Note: Here, the target machine is **Windows Server 2022** (**10.10.1.22**).



8. In the **Parrot Terminal** window, type **unicornscan [Target IP Address] -Iv** (here, the target machine is **Ubuntu** [**10.10.1.9**]) and press **Enter**.
9. The scan results appear, displaying the open TCP ports along with a TTL value of **64**. As shown in the screenshot, the **ttl** value acquired after the scan is **64**; hence, the OS is possibly a Linux-based machine (Google Linux, Ubuntu, Parrot, or Kali). Using this information, attackers can formulate an attack strategy based on the OS of the target system.



10. This concludes the demonstration of discovering the OS of the target machine using Unicornscan.
11. Close all open windows and document all the acquired information.
12. Turn off the **Parrot Security**, **Windows Server 2022** and **Ubuntu** virtual machines.

Lab Analysis

Analyze and document the results of this lab exercise.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Internet Connection Required	
☐ Yes	☑ No
Platform Supported	
☑ Classroom	☑ CyberQ

Lab 4

Scan beyond IDS and Firewall

Scanning beyond IDS and firewall is a process of sending intended packets to the target system in order to exploit IDS/firewall limitations.

Lab Scenario

As a professional ethical hacker or a pen tester, the next step after discovering the OS of the target IP address(es) is to perform network scanning without being detected by the network security perimeters such as the firewall and IDS. IDSs and firewalls are efficient security mechanisms; however, they still have some security limitations. You may be required to launch attacks to exploit these limitations using various IDS/firewall evasion techniques such as packet fragmentation, source routing, IP address spoofing, etc. Scanning beyond the IDS and firewall allows you to evaluate the target network's IDS and firewall security.

Lab Objectives

- Scan beyond IDS/firewall using various evasion techniques
- Create custom packets using Colasoft Packet Builder to scan beyond the IDS/firewall
- Create custom UDP and TCP packets using Hping3 to scan beyond the IDS/firewall
- Browse anonymously using Proxy Switcher
- Browse anonymously using CyberGhost VPN

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 40 Minutes

Overview of Scanning beyond IDS and Firewall

An Intrusion Detection System (IDS) and firewall are the security mechanisms intended to prevent an unauthorized person from accessing a network. However, even IDSs and firewalls have some security limitations. Firewalls and IDSs intend to avoid malicious traffic (packets) from entering into a network, but certain techniques can be used to send intended packets to the target and evade IDSs/firewalls.

Techniques to evade IDS/firewall:

- **Packet Fragmentation**: Send fragmented probe packets to the intended target, which re-assembles it after receiving all the fragments
- **Source Routing**: Specifies the routing path for the malformed packet to reach the intended target
- **Source Port Manipulation**: Manipulate the actual source port with the common source port to evade IDS/firewall
- **IP Address Decoy**: Generate or manually specify IP addresses of the decoys so that the IDS/firewall cannot determine the actual IP address
- **IP Address Spoofing**: Change source IP addresses so that the attack appears to be coming in as someone else
- **Creating Custom Packets**: Send custom packets to scan the intended target beyond the firewalls
- **Randomizing Host Order**: Scan the number of hosts in the target network in a random order to scan the intended target that is lying beyond the firewall
- **Sending Bad Checksums**: Send the packets with bad or bogus TCP/UPD checksums to the intended target
- **Proxy Servers**: Use a chain of proxy servers to hide the actual source of a scan and evade certain IDS/firewall restrictions
- **Anonymizers**: Use anonymizers that allow them to bypass Internet censors and evade certain IDS and firewall rules

Lab Tasks

Task 1: Scan beyond IDS/Firewall using Various Evasion Techniques

Nmap offers many features to help understand complex networks with enabled security mechanisms and supports mechanisms for bypassing poorly implemented defenses. Using Nmap, various techniques can be implemented, which can bypass the IDS/firewall security mechanisms.

Here, we will use Nmap to evade IDS/firewall using various techniques such as packet fragmentation, source port manipulation, MTU, and IP address decoy.

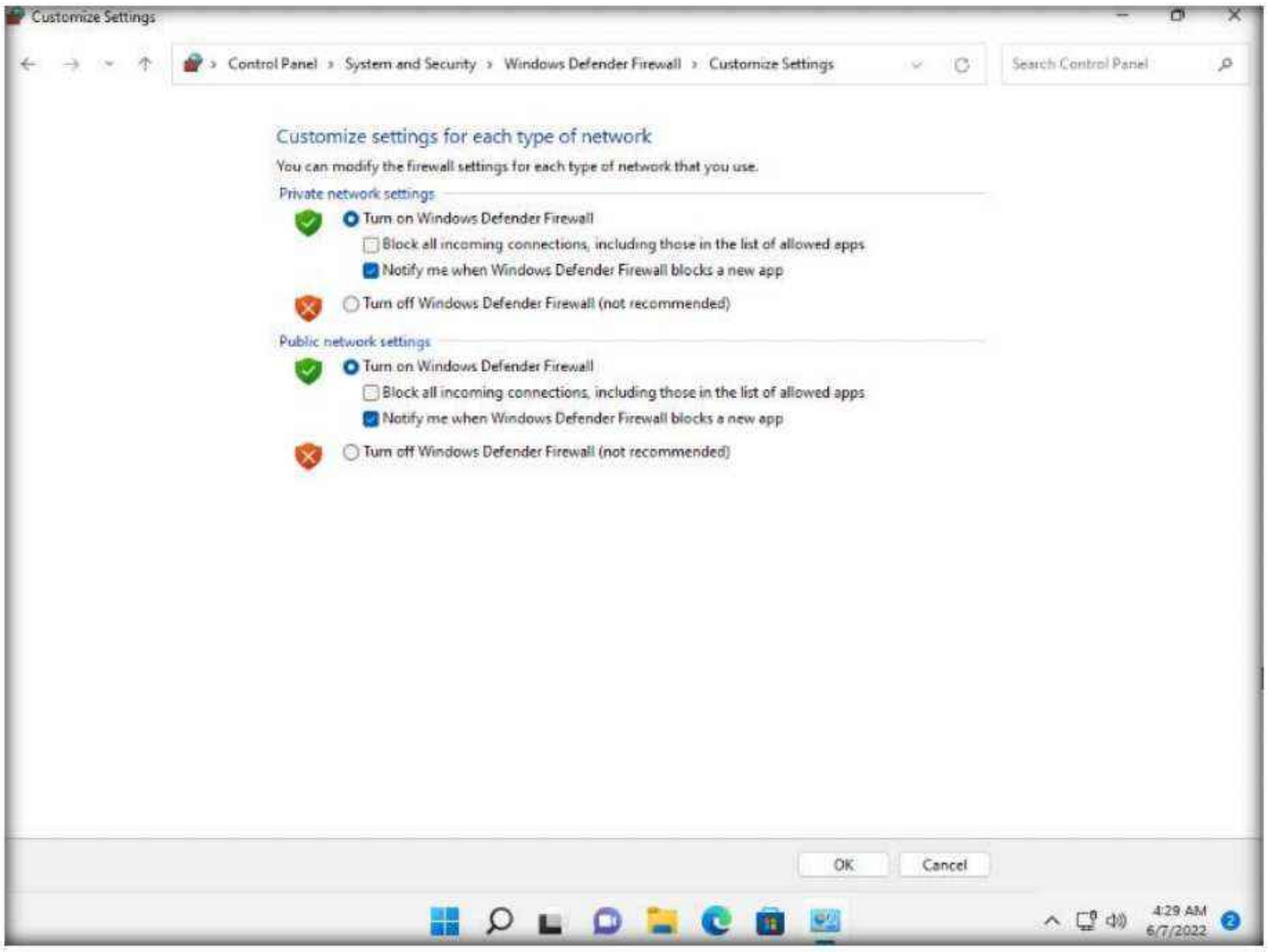
1. Turn on the **Windows 11** and **Parrot Security** virtual machines.

2. Switch to the **Windows 11** virtual machine. By default, **Admin** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.

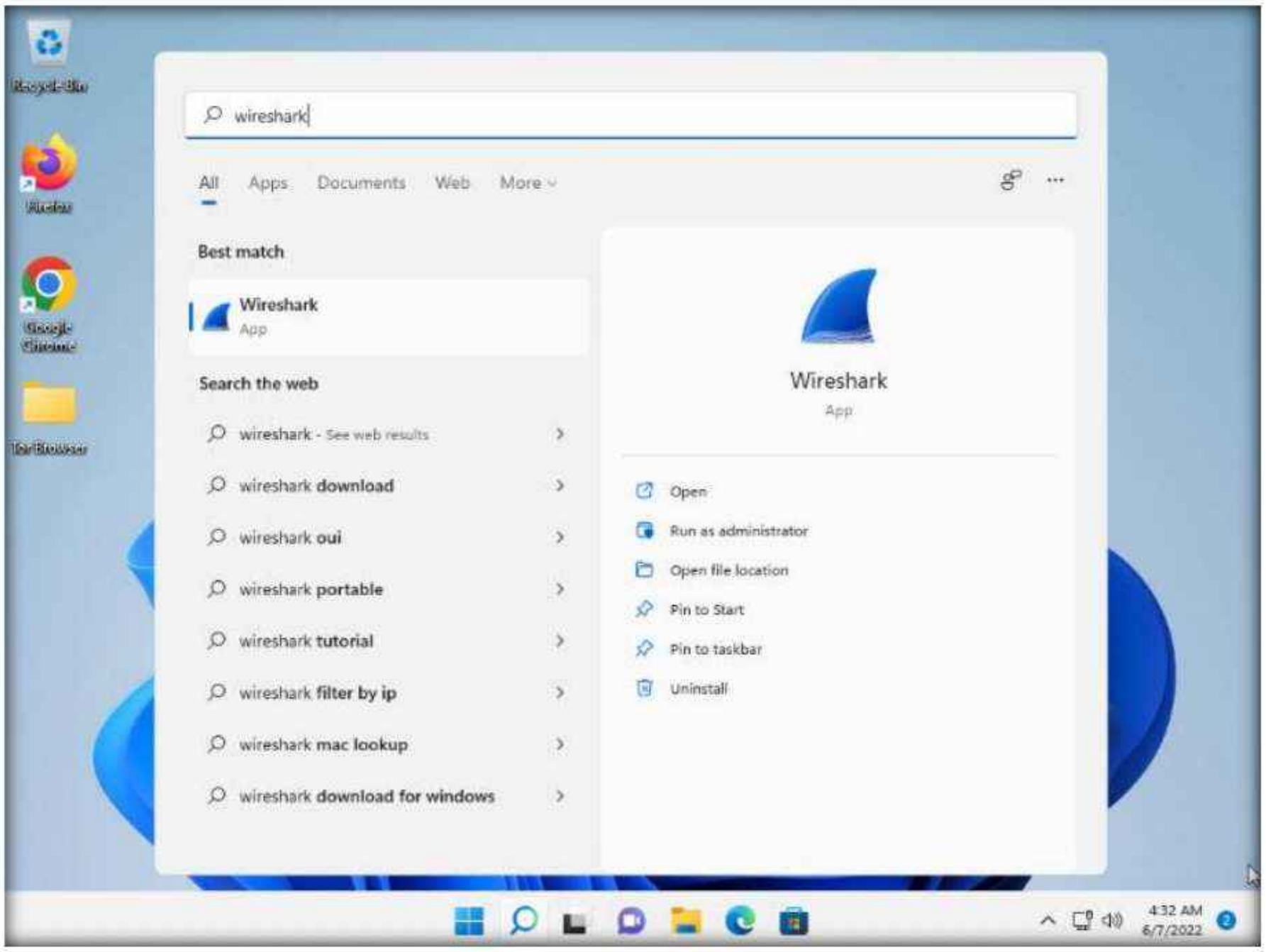
   Note: If **Welcome to Windows** wizard appears, click **Continue** and in **Sign in with Microsoft** wizard, click **Cancel**.

   Note: Networks screen appears, click **Yes** to allow your PC to be discoverable by other PCs and devices on the network.

3. Navigate to **Control Panel → System and Security → Windows Defender Firewall → Turn Windows Defender Firewall on or off**, enable Windows Defender Firewall and click **OK**, as shown in the screenshot.

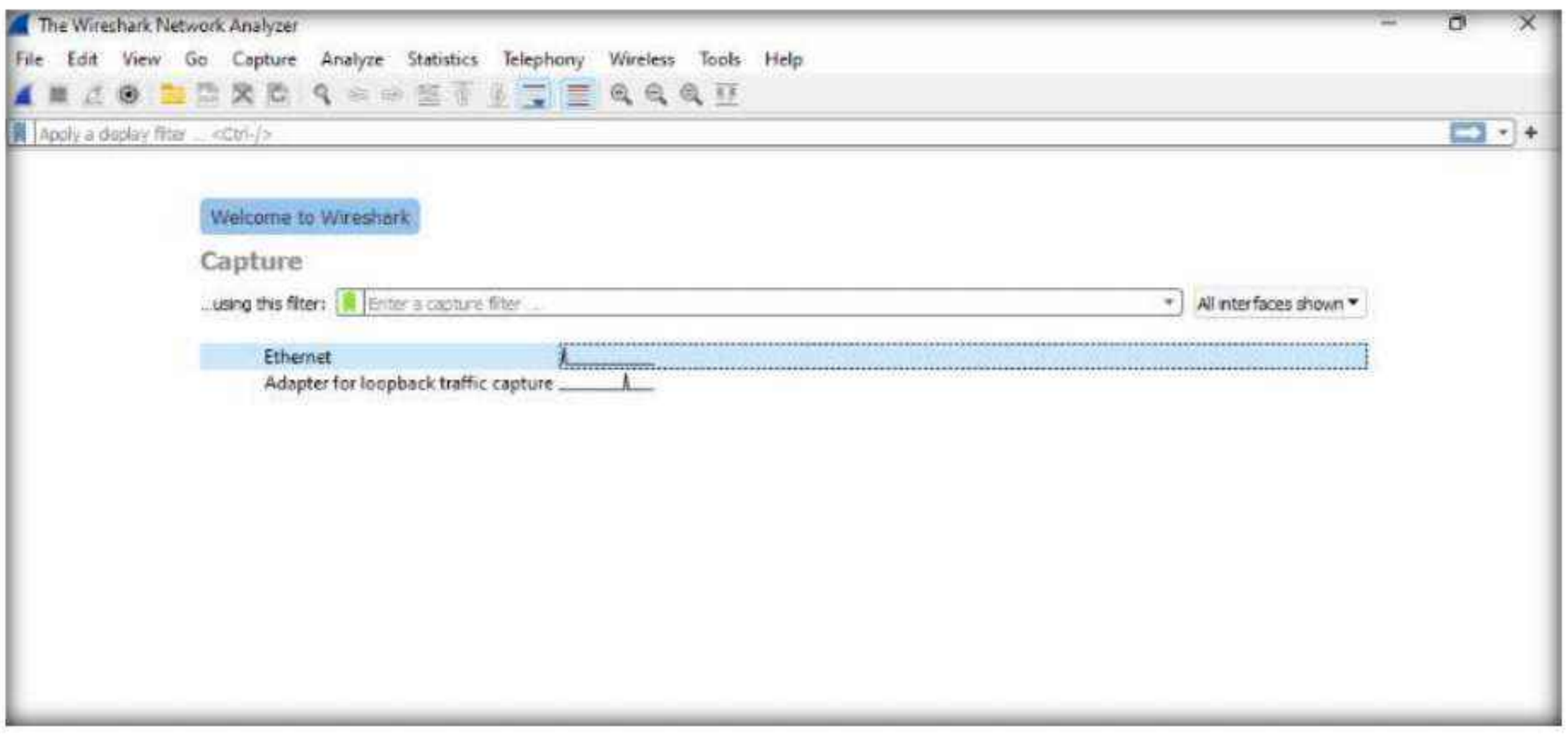


4. Minimize the **Control Panel** window, click **Search** icon ( ) on the **Desktop**. Type **wireshark** in the search field, the **Wireshark** appears in the results, click **Open** to launch it.



5. The **Wireshark Network Analyzer** window appears, Start capturing packets by double-clicking the available ethernet or interface (here, **Ethernet**).

   Note: If **Software Update** window appears, click **Remind me later**.

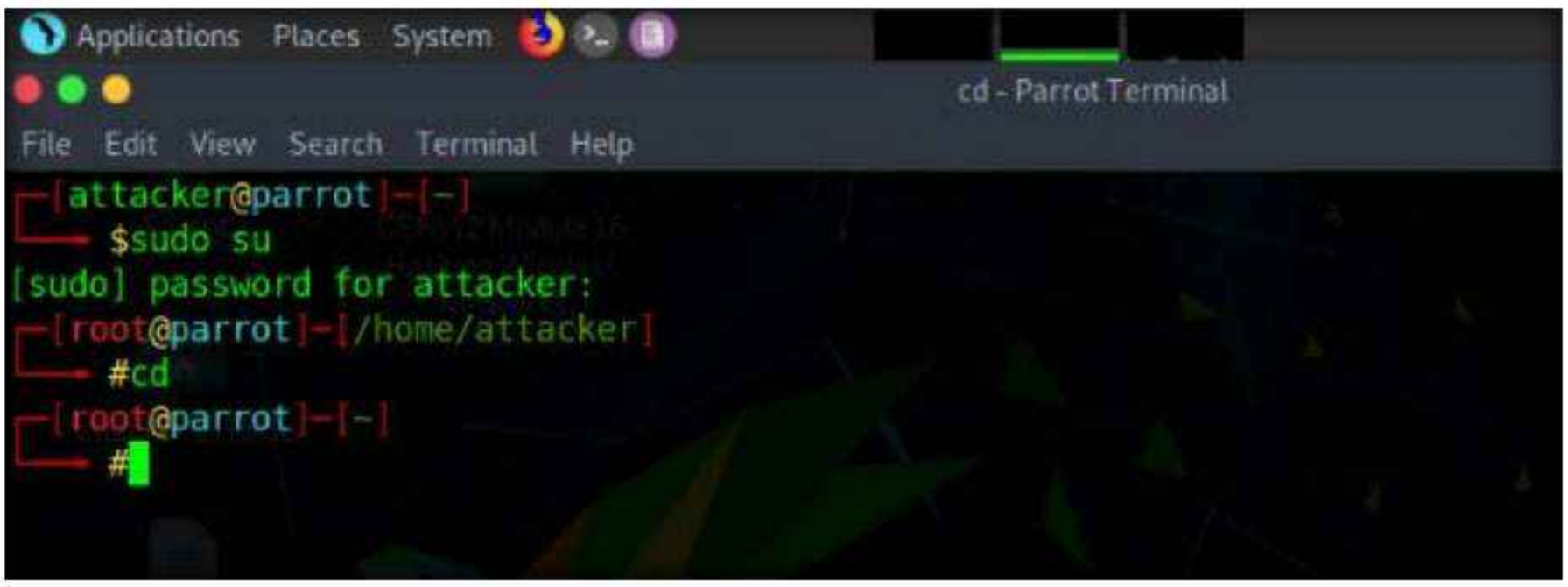


6. Switch to the **Parrot Security** virtual machine.
7. In the login page, the **attacker** username will be selected by default. Enter password as **toor** in the **Password** field and press **Enter** to log in to the machine.

   Note: If a **Parrot Updater** pop-up appears at the top-right corner of **Desktop**, ignore and close it.

   Note: If a **Question** pop-up window appears asking you to update the machine, click **No** to close the window.
8. Click the **MATE Terminal** icon in the top-left corner of the **Desktop** to open a **Terminal** window.
9. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
10. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

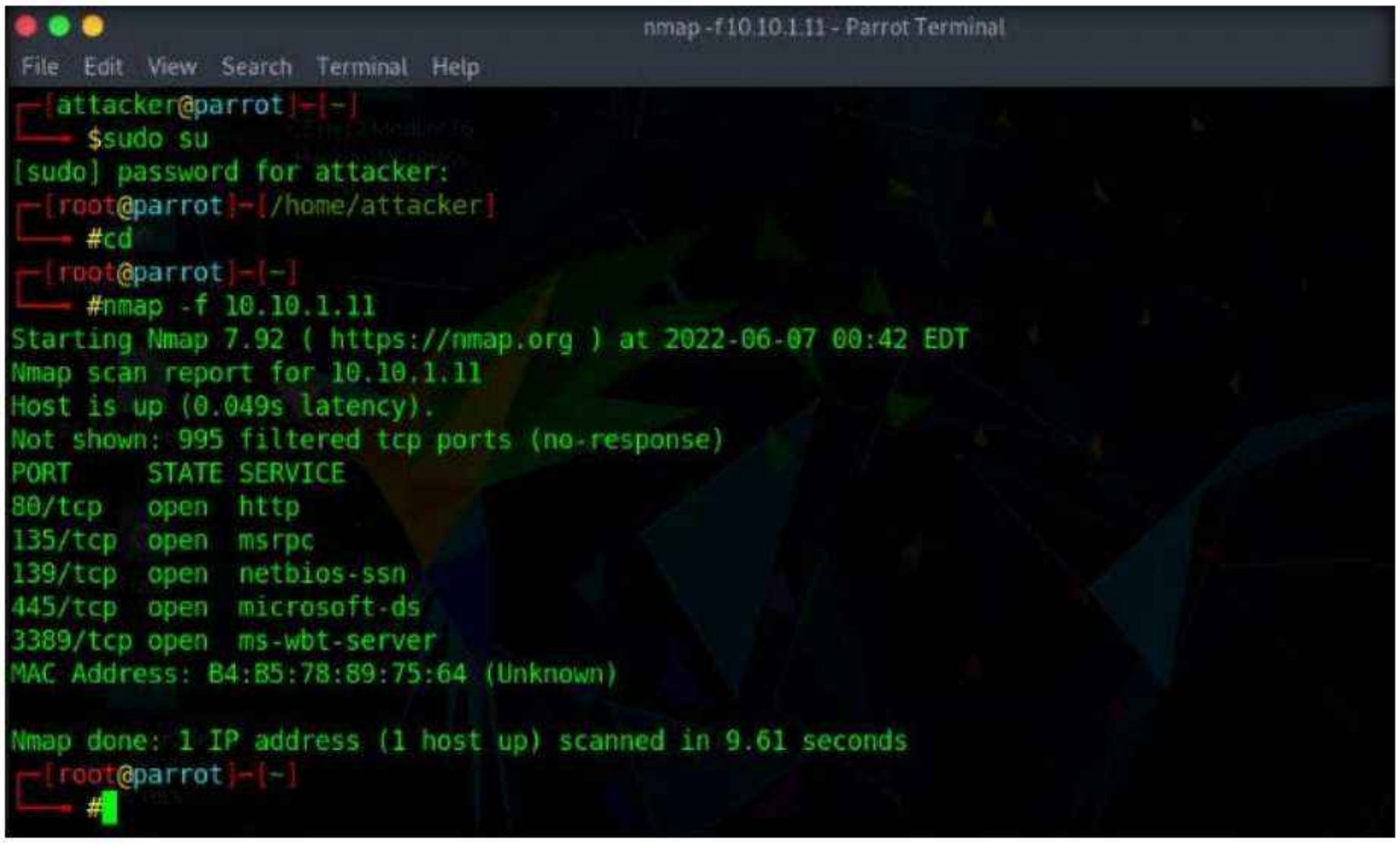
    Note: The password that you type will not be visible.
11. Now, type **cd** and press **Enter** to jump to the root directory.



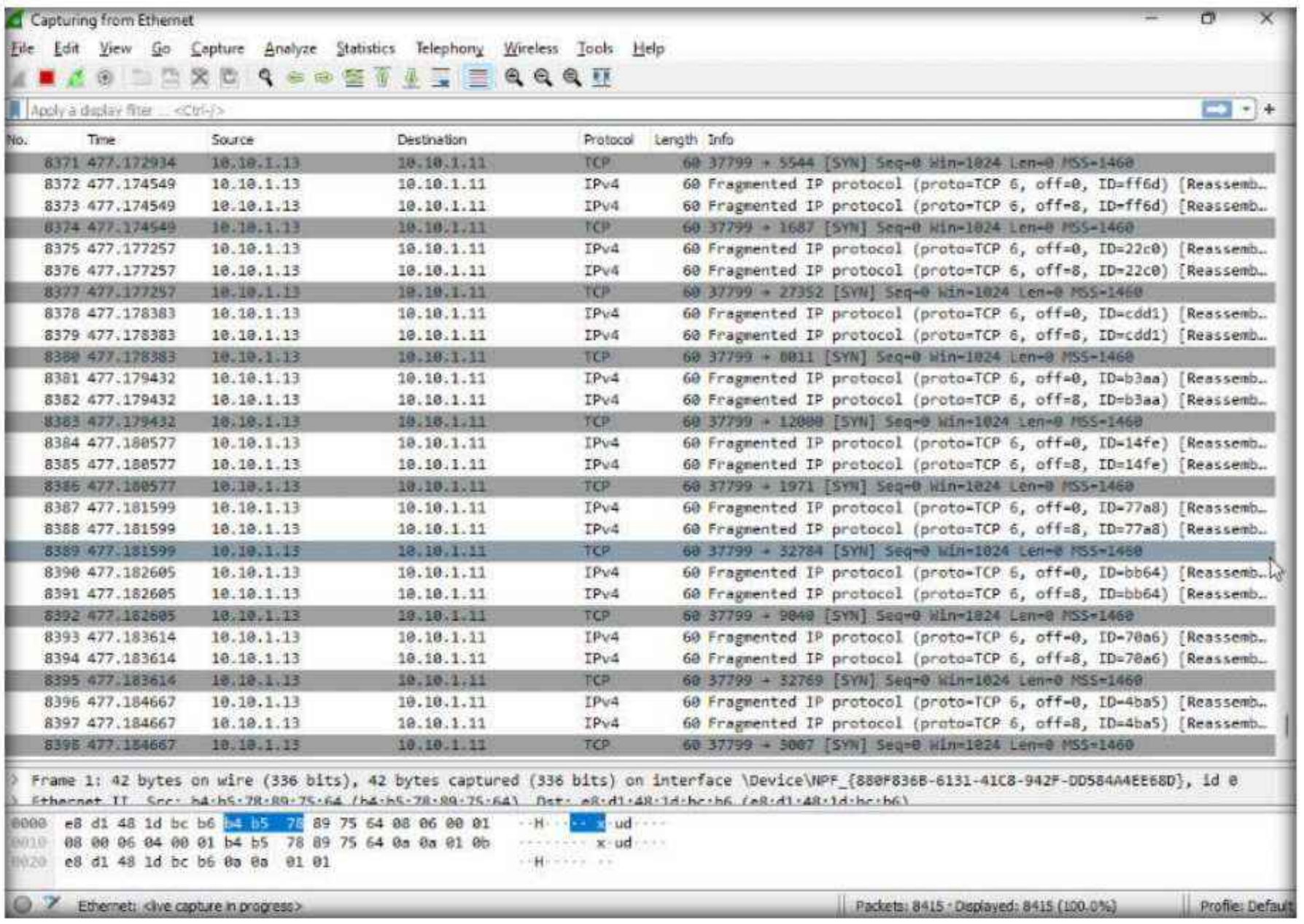
12. In the terminal window, type **nmap -f [Target IP Address]**, (here, the target machine is **Windows 11** [**10.10.1.11**]) and press **Enter**.

    Note: **-f** switch is used to split the IP packet into tiny fragment packets.

    Note: Packet fragmentation refers to the splitting of a probe packet into several smaller packets (fragments) while sending it to a network. When these packets reach a host, IDSs and firewalls behind the host generally queue all of them and process them one by one. However, since this method of processing involves greater CPU consumption as well as network resources, the configuration of most of IDSs makes it skip fragmented packets during port scans.
13. Although **Windows Defender Firewall** is turned on in the target system (here, **Windows 11**), you can still obtain the results displaying all open TCP ports along with the name of services running on the ports, as shown in the screenshot.



14. Switch to the **Windows 11** virtual machine (target machine). You can observe the fragmented packets captured by the Wireshark, as shown in the screenshot.

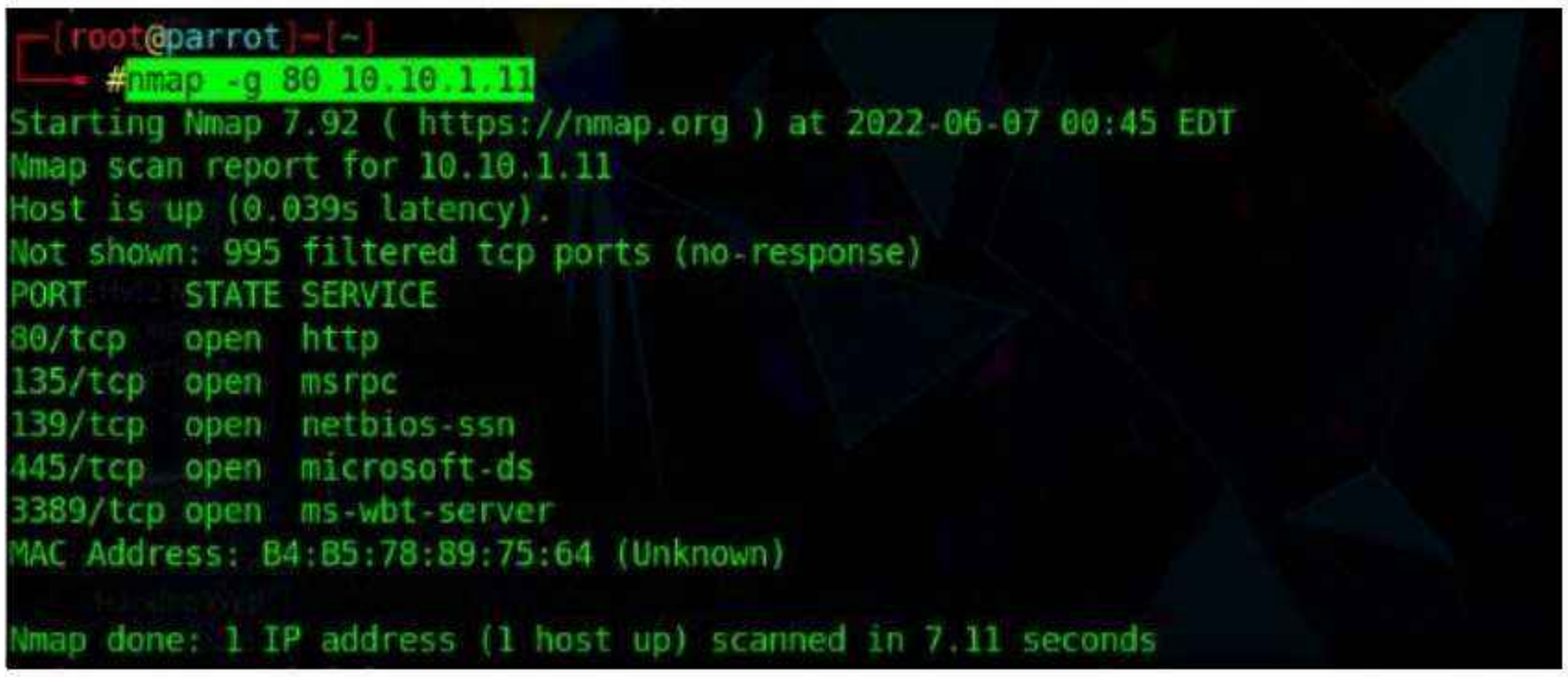


15. Switch to the **Parrot Security** virtual machine.
16. In the **Parrot Terminal** window, type **nmap -g 80 [Target IP Address]**, (here, target IP address is **10.10.1.11**) and press **Enter**.

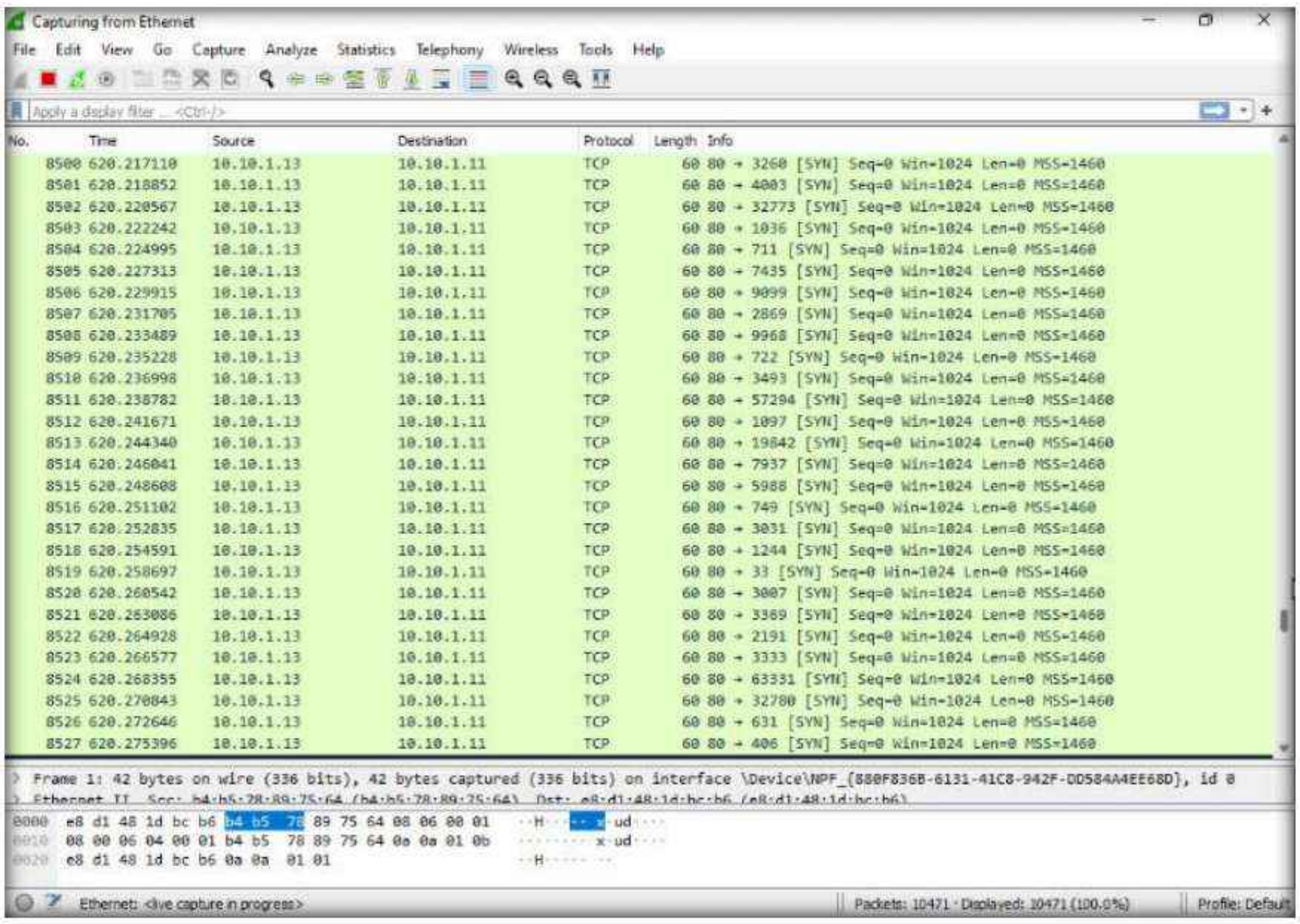
Note: In this command, you can use the **-g** or **--source-port** option to perform source port manipulation.

Note: Source port manipulation refers to manipulating actual port numbers with common port numbers to evade IDS/firewall: this is useful when the firewall is configured to allow packets from well-known ports like HTTP, DNS, FTP, etc.

17. The results appear, displaying all open TCP ports along with the name of services running on the ports, as shown in the screenshot.



18. Switch to the **Windows 11** virtual machine (target machine). In the Wireshark window, scroll-down and you can observe the TCP packets indicating that the port number 80 is used to scan other ports of the target host, as shown in the screenshot.



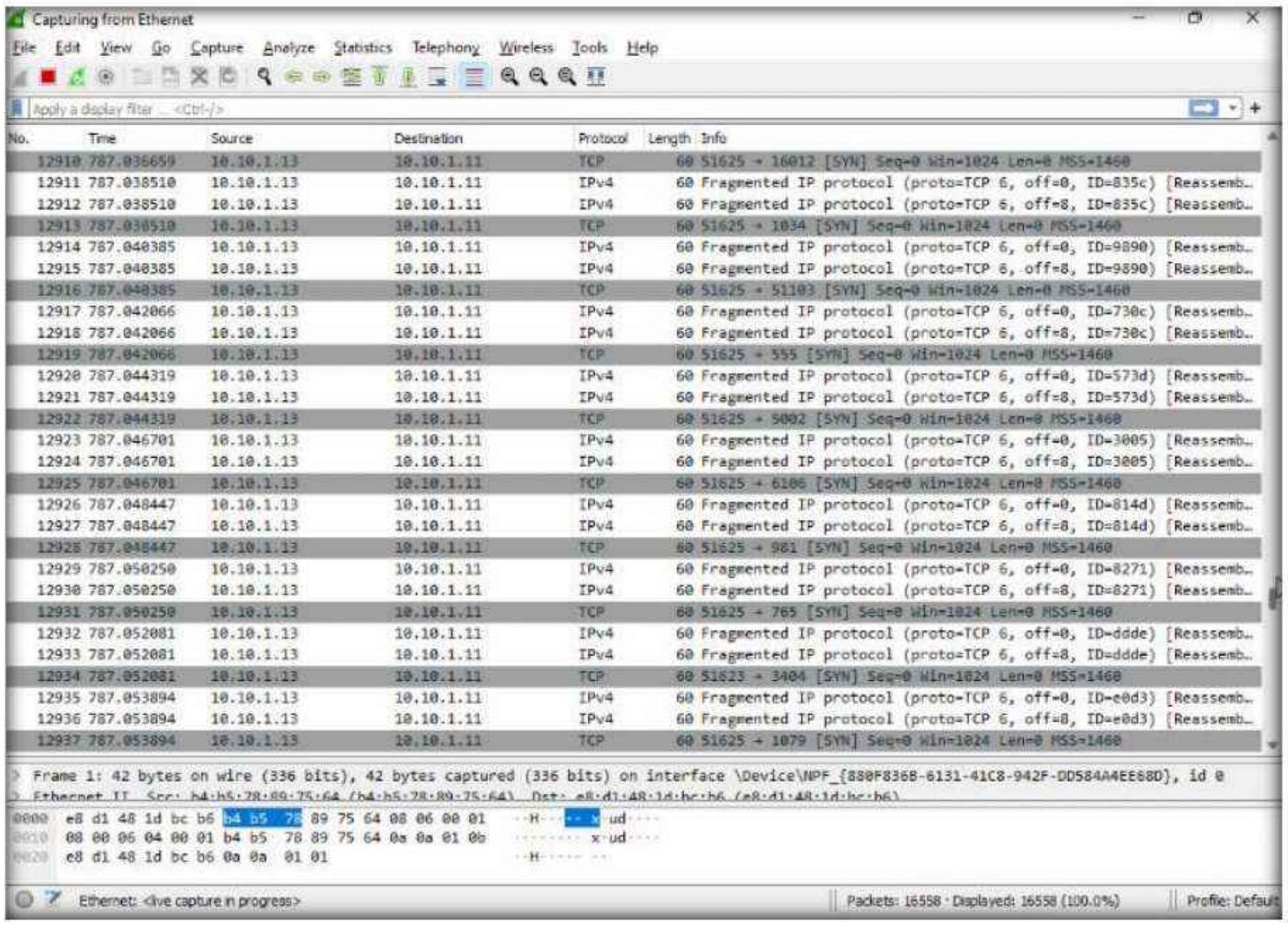
19. Switch to the **Parrot Security** virtual machine.
20. Now, type **nmap -mtu 8 [Target IP Address]** (here, target IP address is **10.10.1.11**) and press **Enter**.

    Note: In this command, **-mtu**: specifies the number of Maximum Transmission Unit (MTU) (here, **8** bytes of packets).

    Note: Using MTU, smaller packets are transmitted instead of sending one complete packet at a time. This technique evades the filtering and detection mechanism enabled in the target machine.

```
┌─[root@parrot]─[~]
└──╼ #nmap -mtu 8 10.10.1.11
Starting Nmap 7.92 ( https://nmap.org ) at 2022-06-07 00:48 EDT
Nmap scan report for 10.10.1.11
Host is up (0.042s latency).
Not shown: 995 filtered tcp ports (no-response)
PORT     STATE SERVICE
80/tcp   open  http
135/tcp  open  msrpc
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
3389/tcp open  ms-wbt-server
MAC Address: B4:B5:78:89:75:64 (Unknown)

Nmap done: 1 IP address (1 host up) scanned in 9.71 seconds
```

21. Switch to the virtual **Windows 11** machine (target machine). In the Wireshark window, scroll-down and you can observe the fragmented packets having maximum length as 8 bytes, as shown in the screenshot.



22. Switch to the **Parrot Security** virtual machine.
23. Now, type **nmap -D RND:10 [Target IP Address]** (here, target IP address is **10.10.1.11**) and press **Enter**.

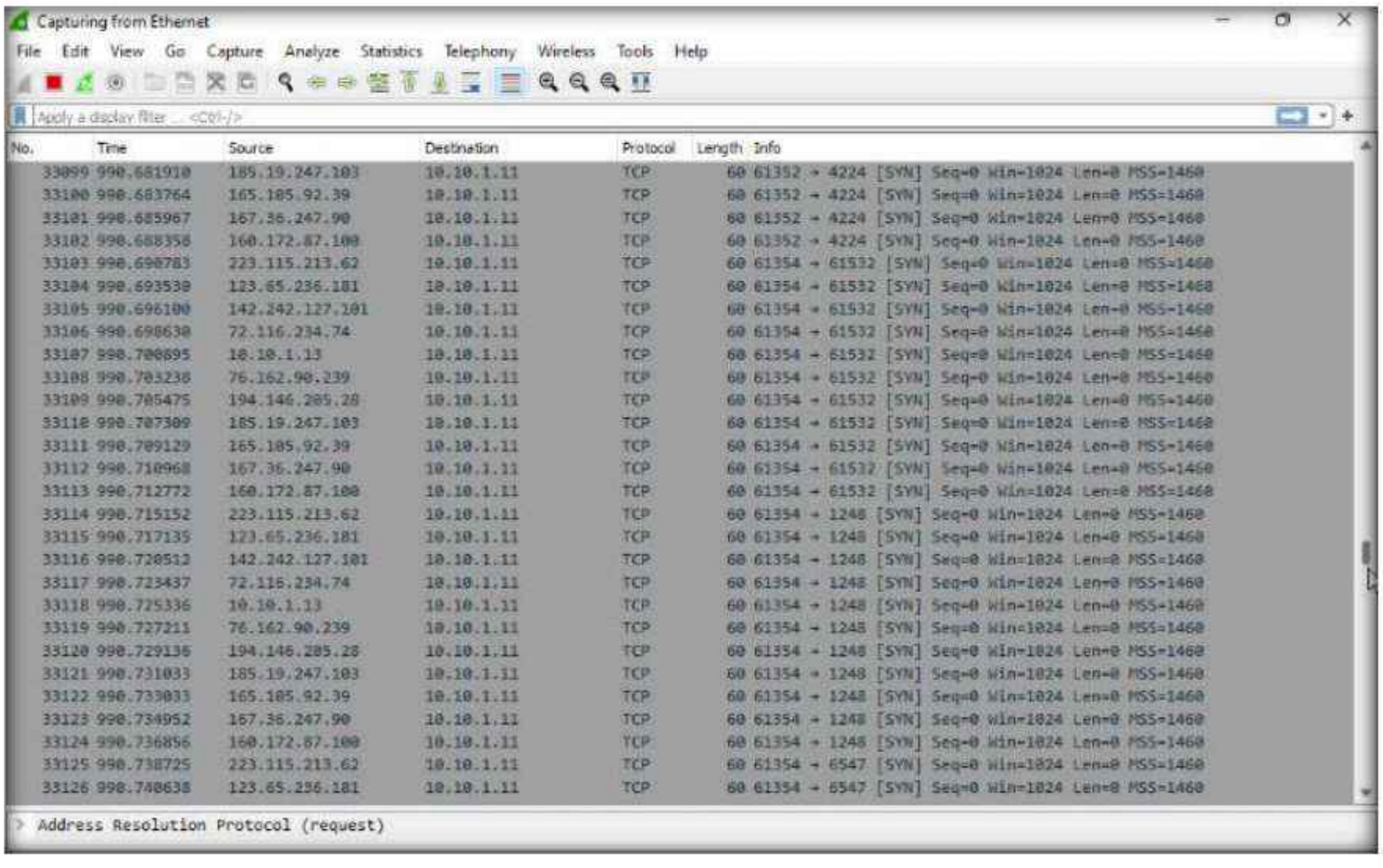
    Note: In this command, **-D**: performs a decoy scan and **RND**: generates random and non-reserved IP addresses (here, **10**).

    Note: The IP address decoy technique refers to generating or manually specifying IP addresses of the decoys to evade IDS/firewall. This technique makes it difficult for the IDS/firewall to determine which IP address was actually scanning the network and which IP addresses were decoys.

    By using this command, Nmap automatically generates a random number of decoys for the scan and randomly positions the real IP address between the decoy IP addresses.

```
┌─[root@parrot]─[~]
└──╼ #nmap -D RND:10 10.10.1.11
Starting Nmap 7.92 ( https://nmap.org ) at 2022-06-07 00:51 EDT
Nmap scan report for 10.10.1.11
Host is up (0.38s latency).
Not shown: 995 filtered tcp ports (no-response)
PORT     STATE SERVICE
80/tcp   open  http
135/tcp  open  msrpc
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
3389/tcp open  ms-wbt-server
MAC Address: B4:B5:78:89:75:64 (Unknown)

Nmap done: 1 IP address (1 host up) scanned in 68.76 seconds
```

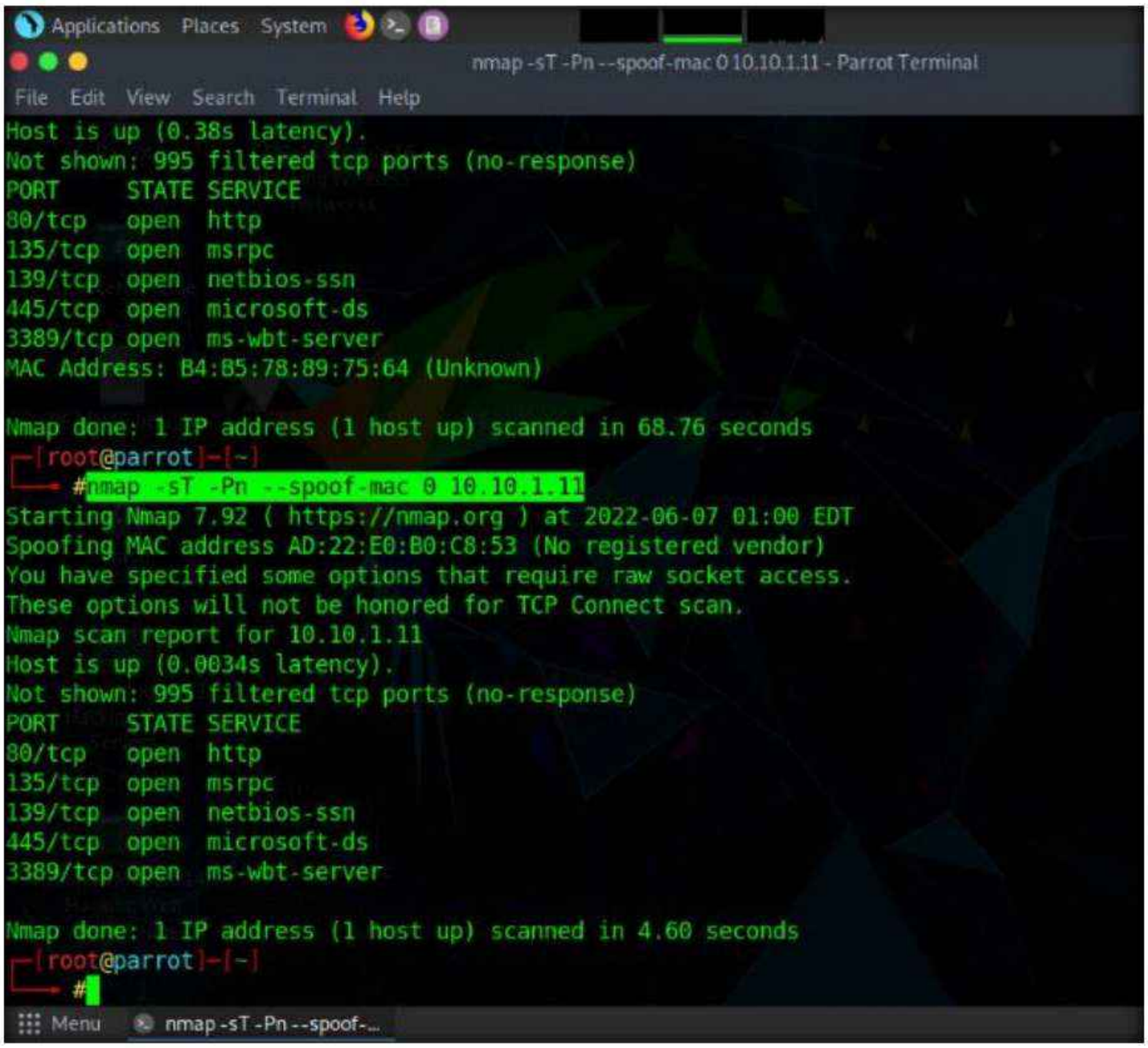
24. Now, switch to the **Windows 11** virtual machine (target machine). In the Wireshark window, scroll-down and you can observe the packets displaying the multiple IP addresses in the source section, as shown in the screenshot.



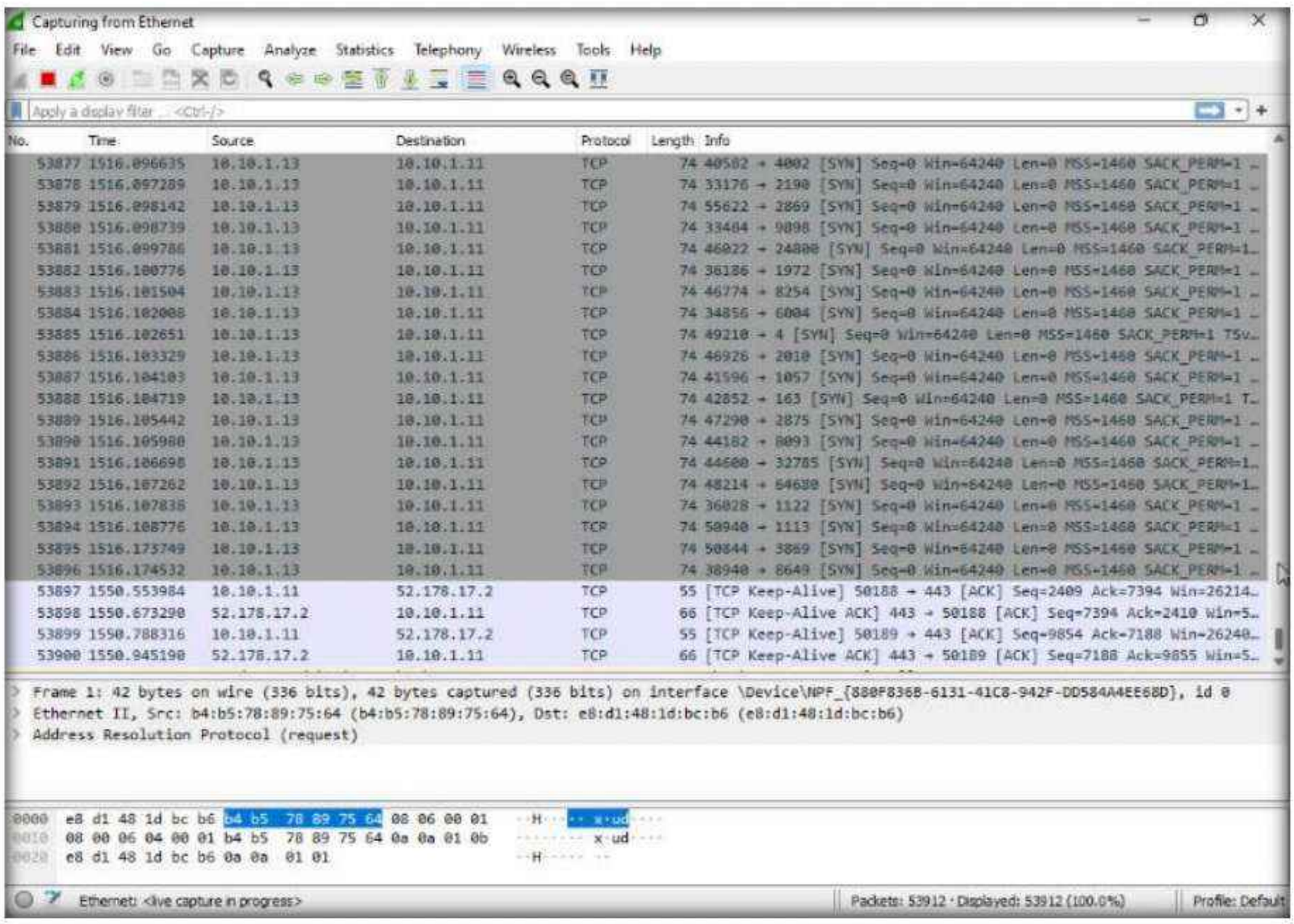
25. Switch to the **Parrot Security** virtual machine.
26. In the terminal window type **nmap -sT -Pn --spoof-mac 0 [Target IP Address]** (here, target IP address is **10.10.1.11**) and press **Enter**.

    Note: In this command **--spoof-mac 0** represents randomizing the MAC address, **-sT**: performs the TCP connect/full open scan, **-Pn** is used to skip the host discovery.

    Note: MAC address spoofing technique involves spoofing a MAC address with the MAC address of a legitimate user on the network. This technique allows you to send request packets to the targeted machine/network pretending to be a legitimate host.



27. Switch to the **Windows 11** virtual machine (target machine). In the Wireshark window, scroll-down and you can observe the captured TCP, as shown in the screenshot.



28. This concludes the demonstration of evading IDS and firewall using various evasion techniques in Nmap.

29. Close all open windows and document all the acquired information.

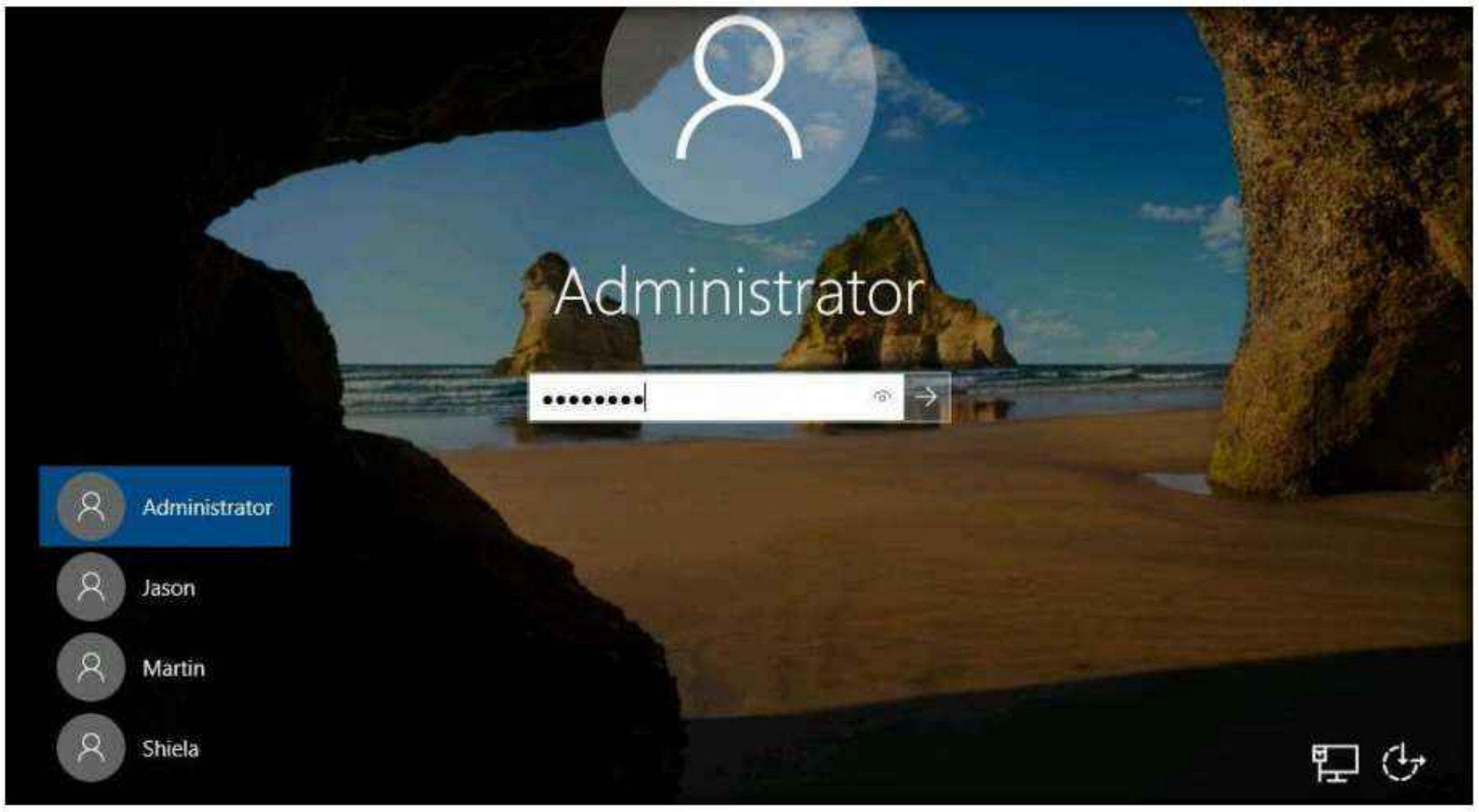
Task 2: Create Custom Packets using Colasoft Packet Builder to Scan beyond the IDS/Firewall

Colasoft Packet Builder is a tool that allows you to create custom network packets to assess network security. You can also select a TCP packet from the provided templates and change the parameters in the decoder editor, hexadecimal editor, or ASCII editor to create a packet. In addition to building packets, the Colasoft Packet Builder supports saving packets to packet files and sending packets to the network.

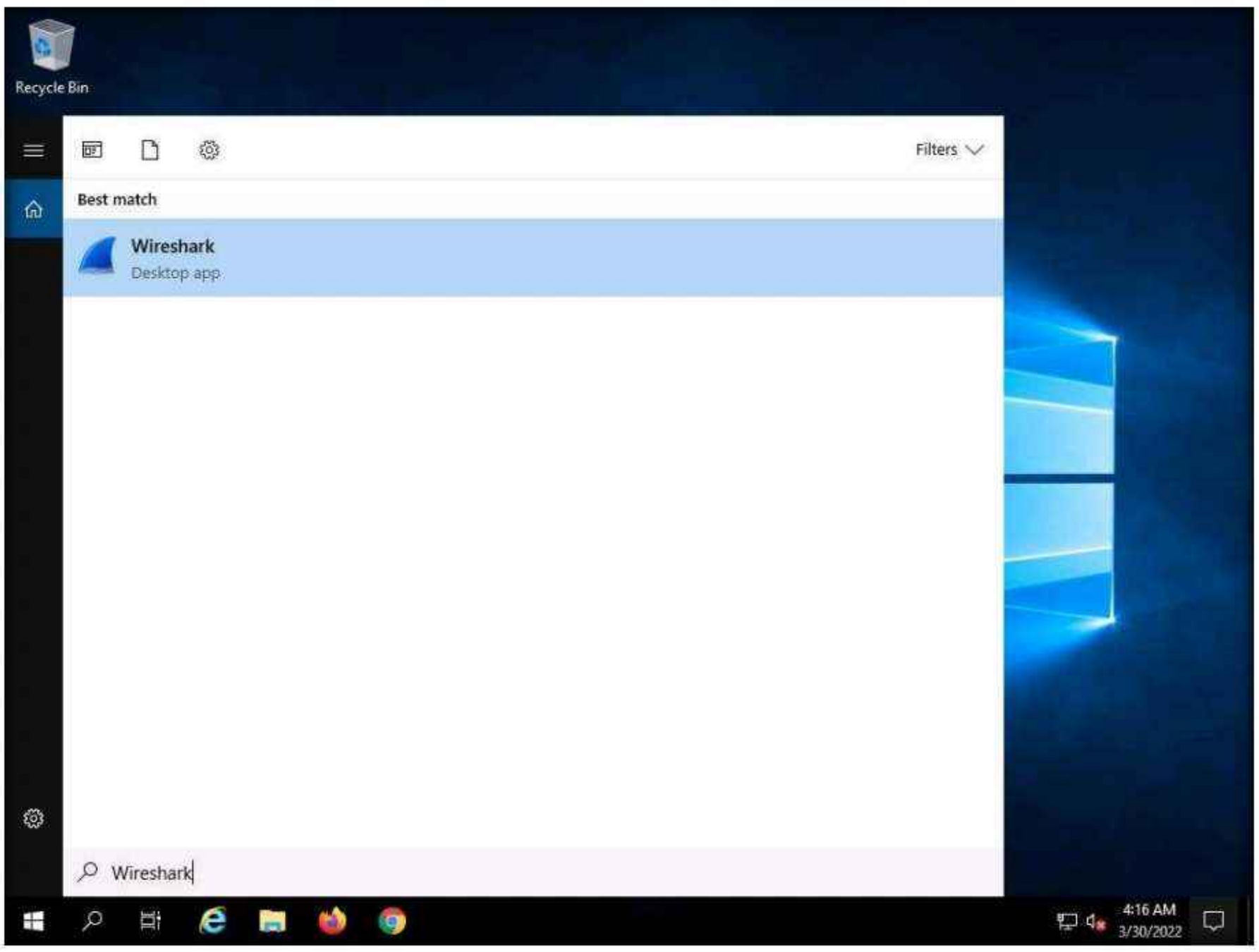
Here, we will use the Colasoft Packet Builder tool to create custom TCP packets to scan the target host by bypassing the IDS/firewall.

1. Turn on the **Windows Server 2019** virtual machine.
2. In the **Windows Server 2019** virtual machine, click **Ctrl+Alt+Del** to activate the machine. By default, **Administrator** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.

Note: Networks screen appears, click **Yes** to allow your PC to be discoverable by other PCs and devices on the network.

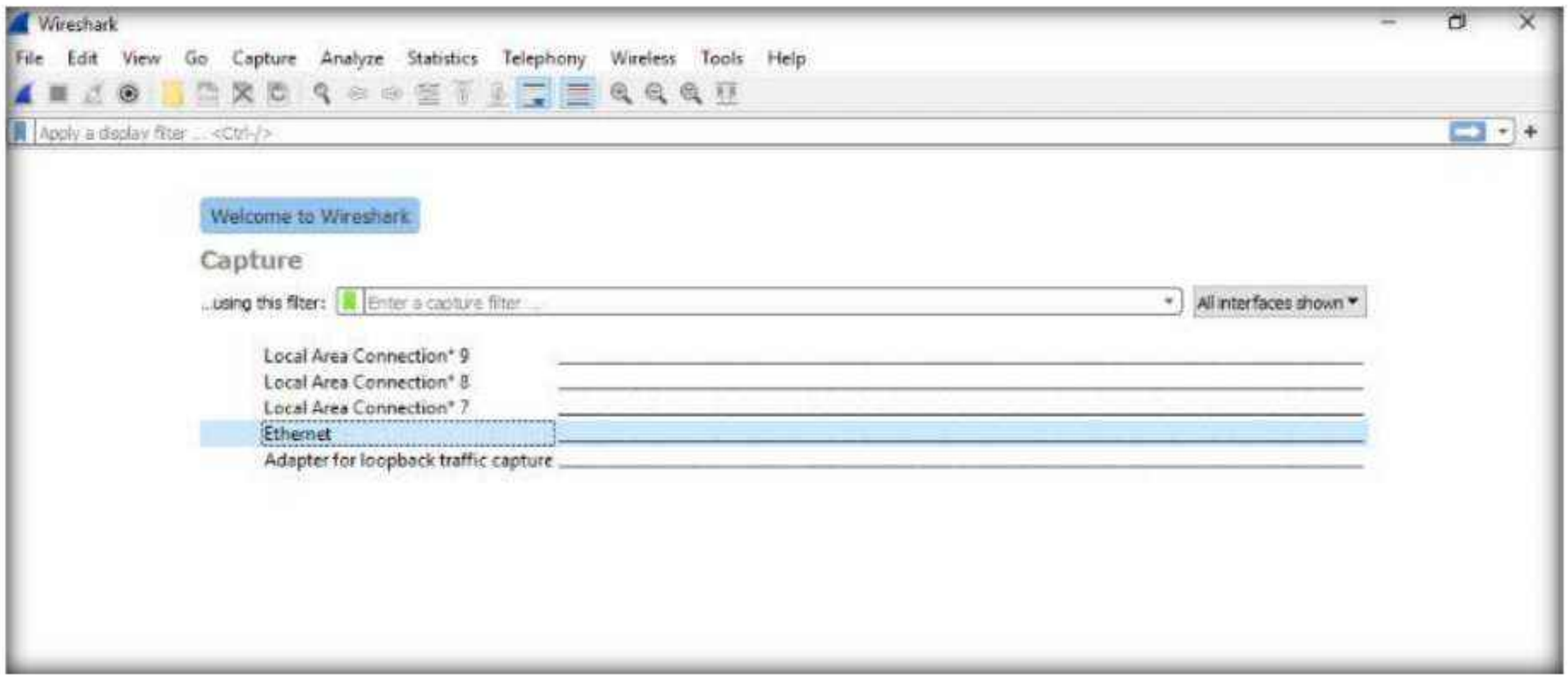


3. Click **Search** icon () on the **Desktop**. Type **wireshark** in the search field, the **Wireshark** appears in the results, click **Wireshark** to launch it.

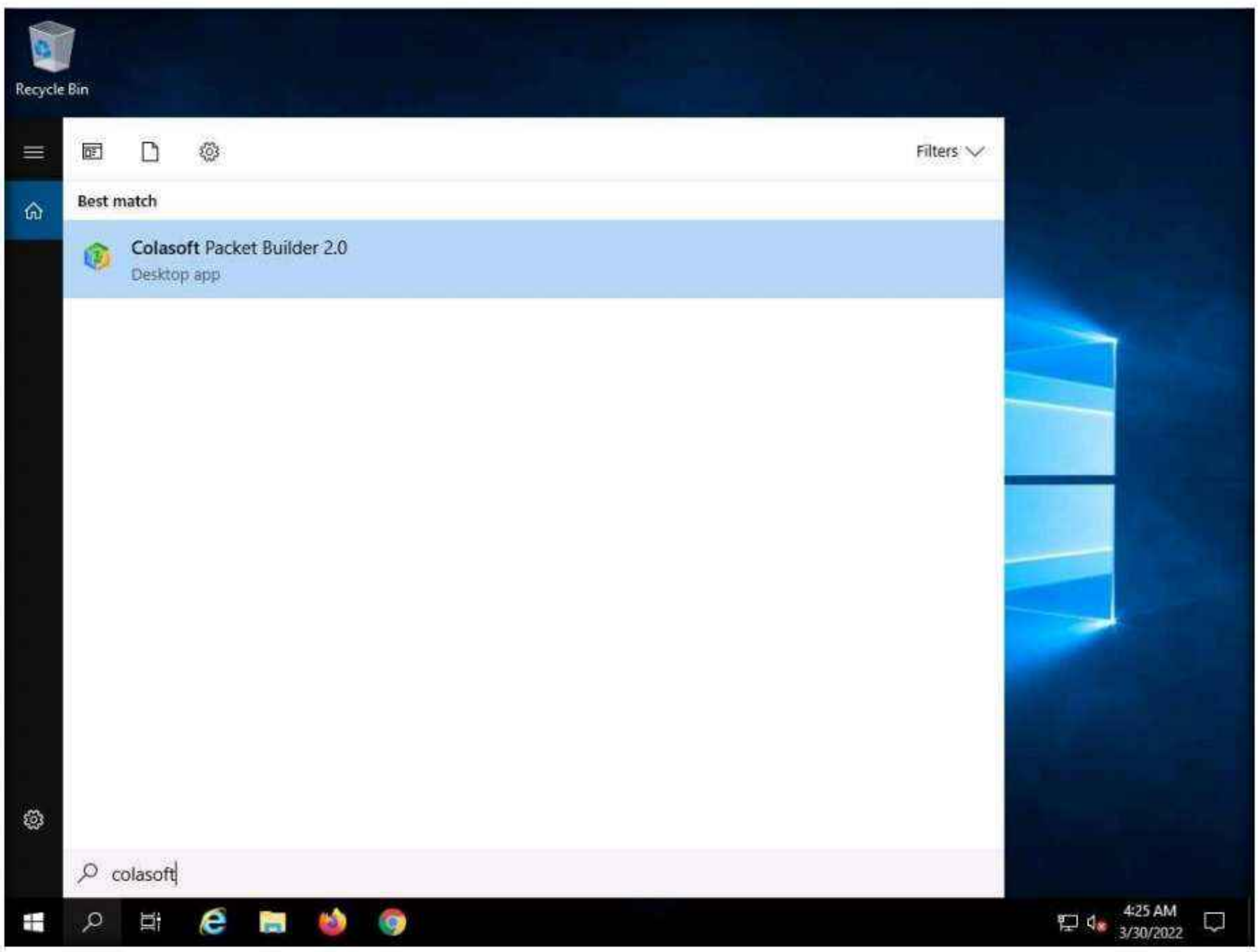


4. The **Wireshark Network Analyzer** main window appears; double-click the available ethernet or interface (here, **Ethernet**) to start the packet capture.

   Note: If a **Software Update** pop-up appears click on **Remind me later**.

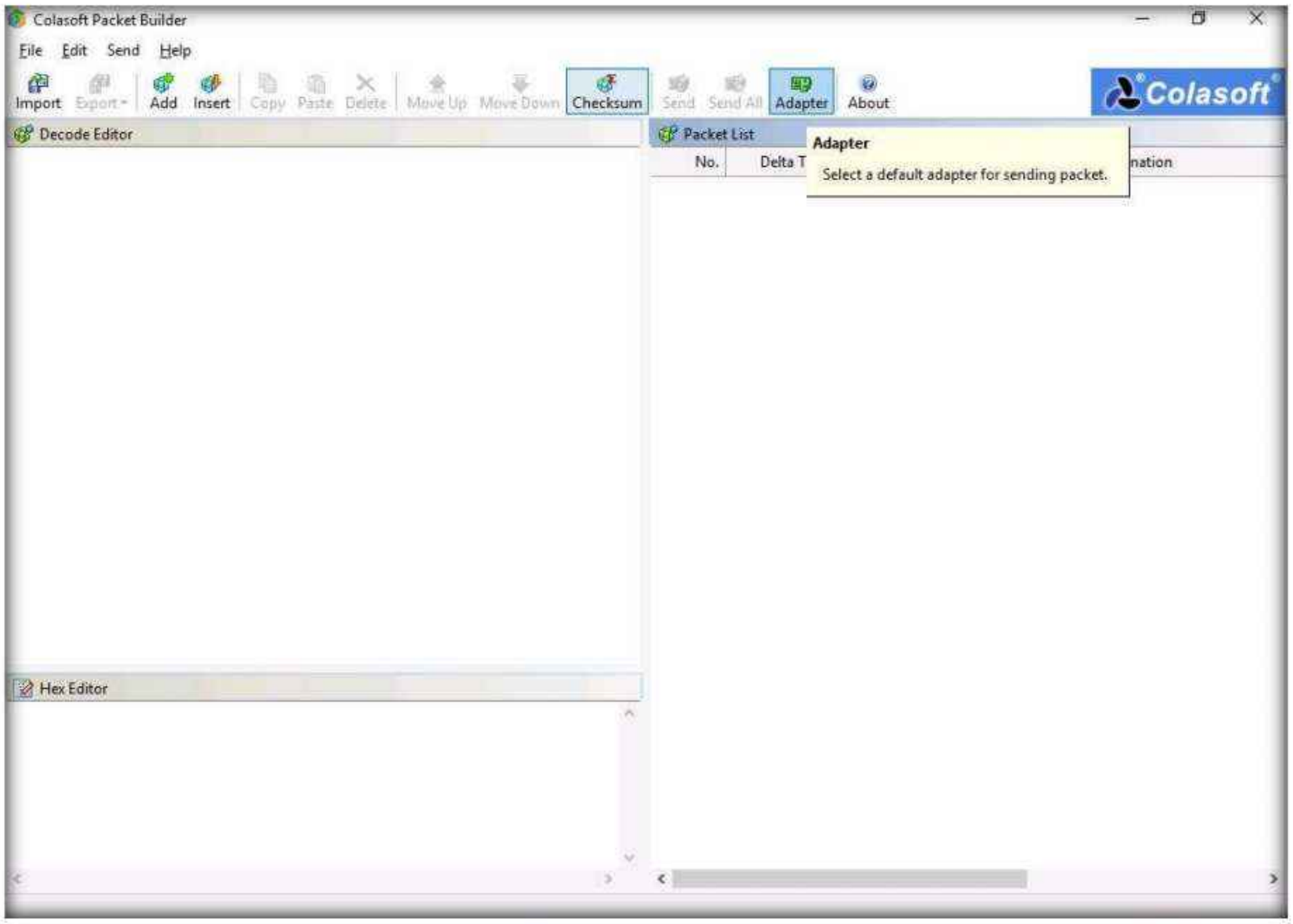


5. Minimize the **Wireshark** window, click **Search** icon ( ) on the **Desktop**. Type **colasoft** in the search field, the **Colasoft Packet Builder 2.0** appears in the results, click **Colasoft Packet Builder 2.0** to launch it.

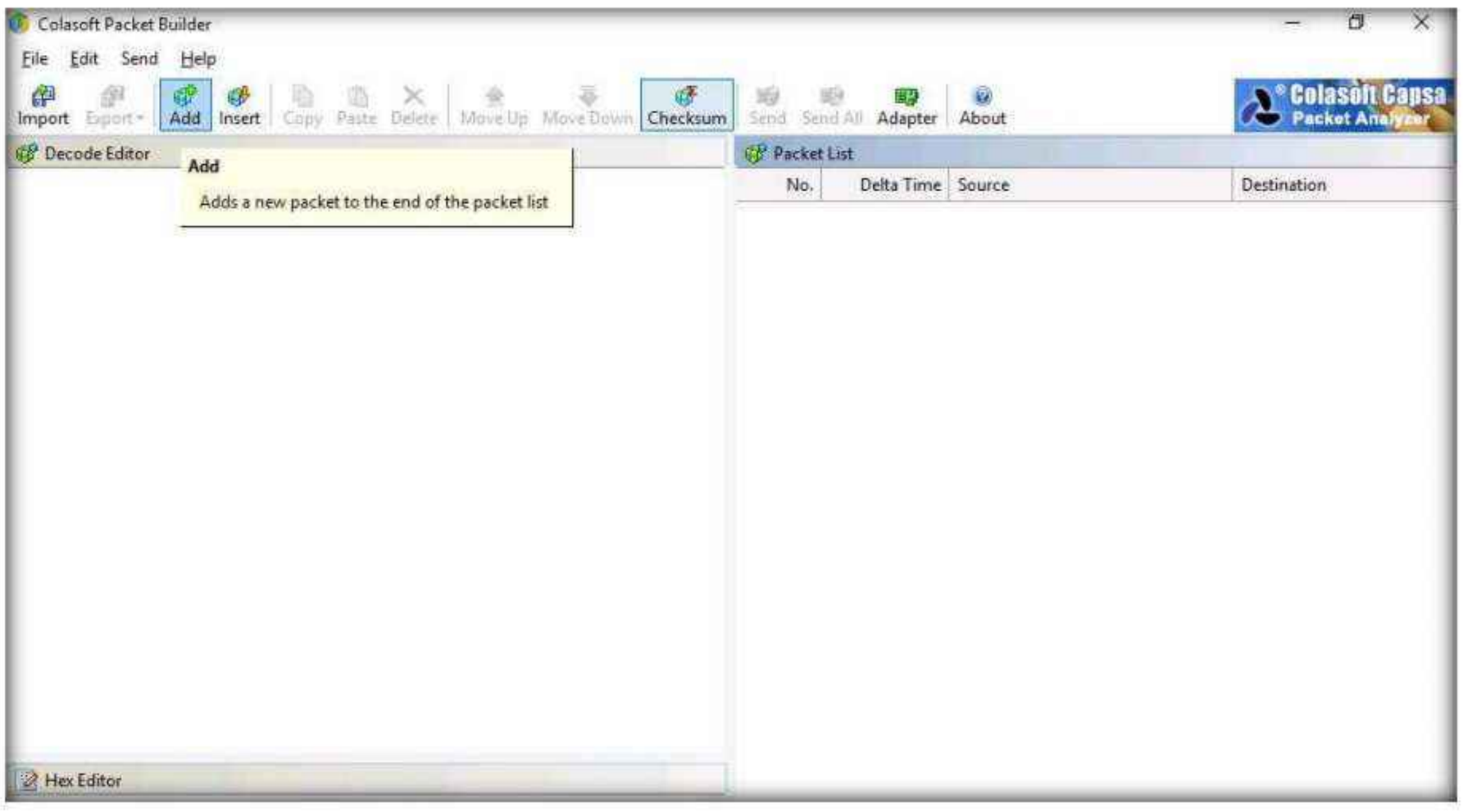


6. The **Colasoft Packet Builder** GUI appears; click on the **Adapter** icon, as shown in the screenshot.

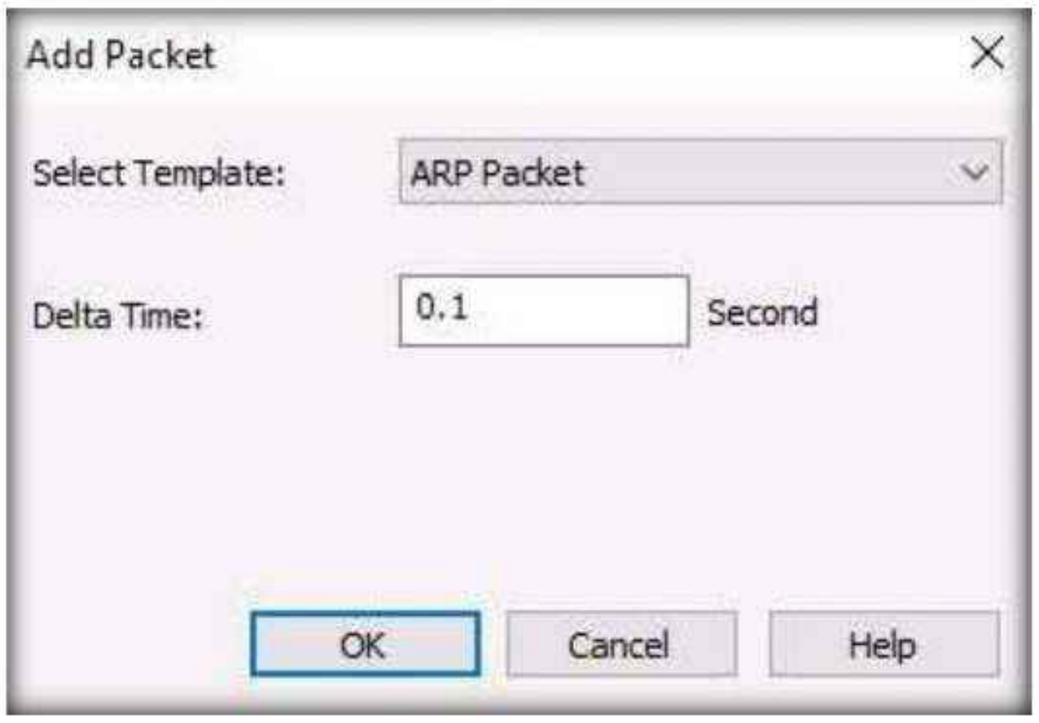
   Note: If a pop-up appears, close the window.



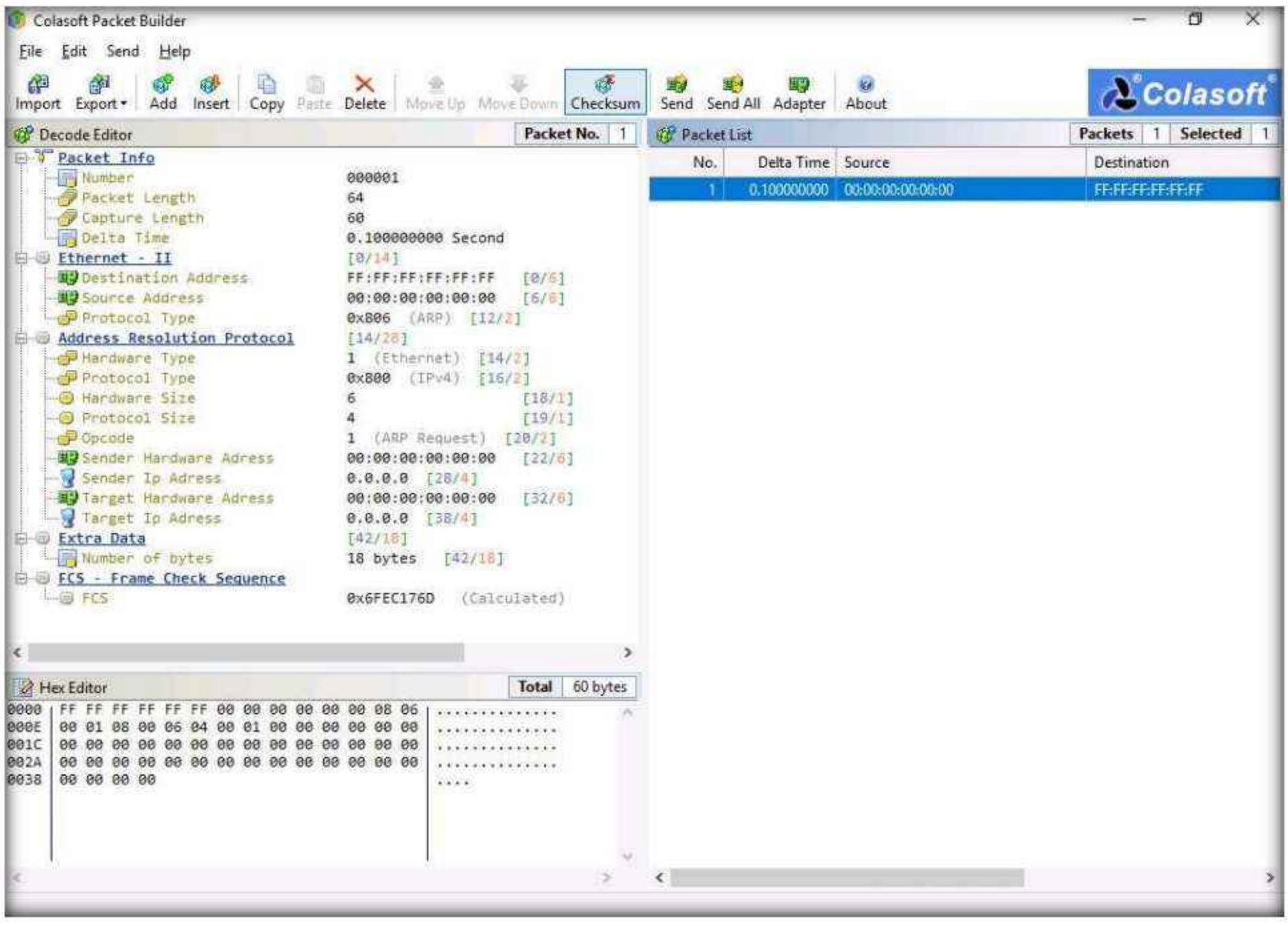
7. When the **Select Adapter** window appears, check the **Adapter** settings and click **OK**.
8. To add or create a packet, click the **Add** icon in the **Menu** bar.



9. In the **Add Packet** dialog box, select the **ARP Packet** template, set **Delta Time** as **0.1** seconds, and click **OK**.

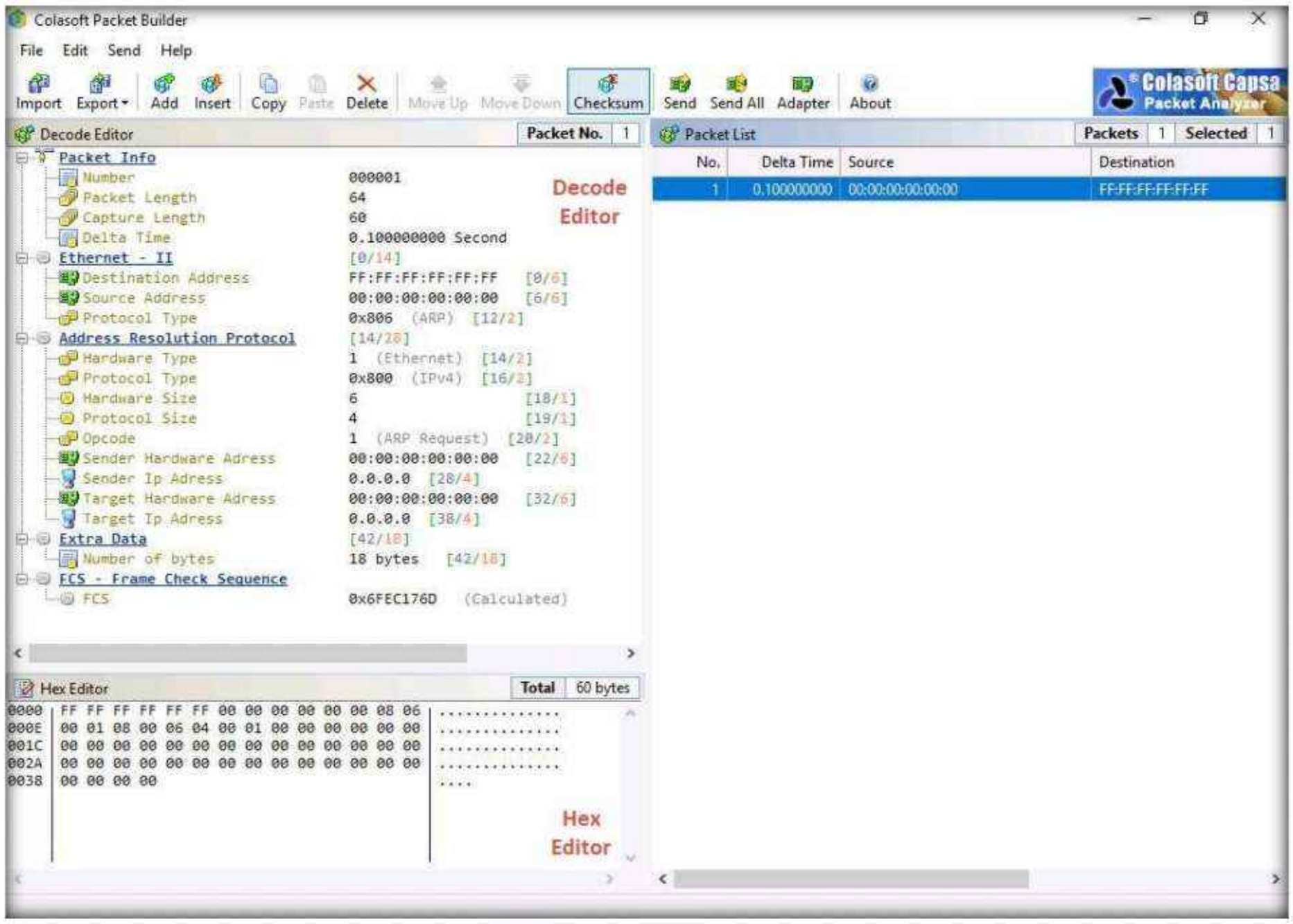


10. You can view the added packets list on the right-hand side of the window, under **Packet List**.

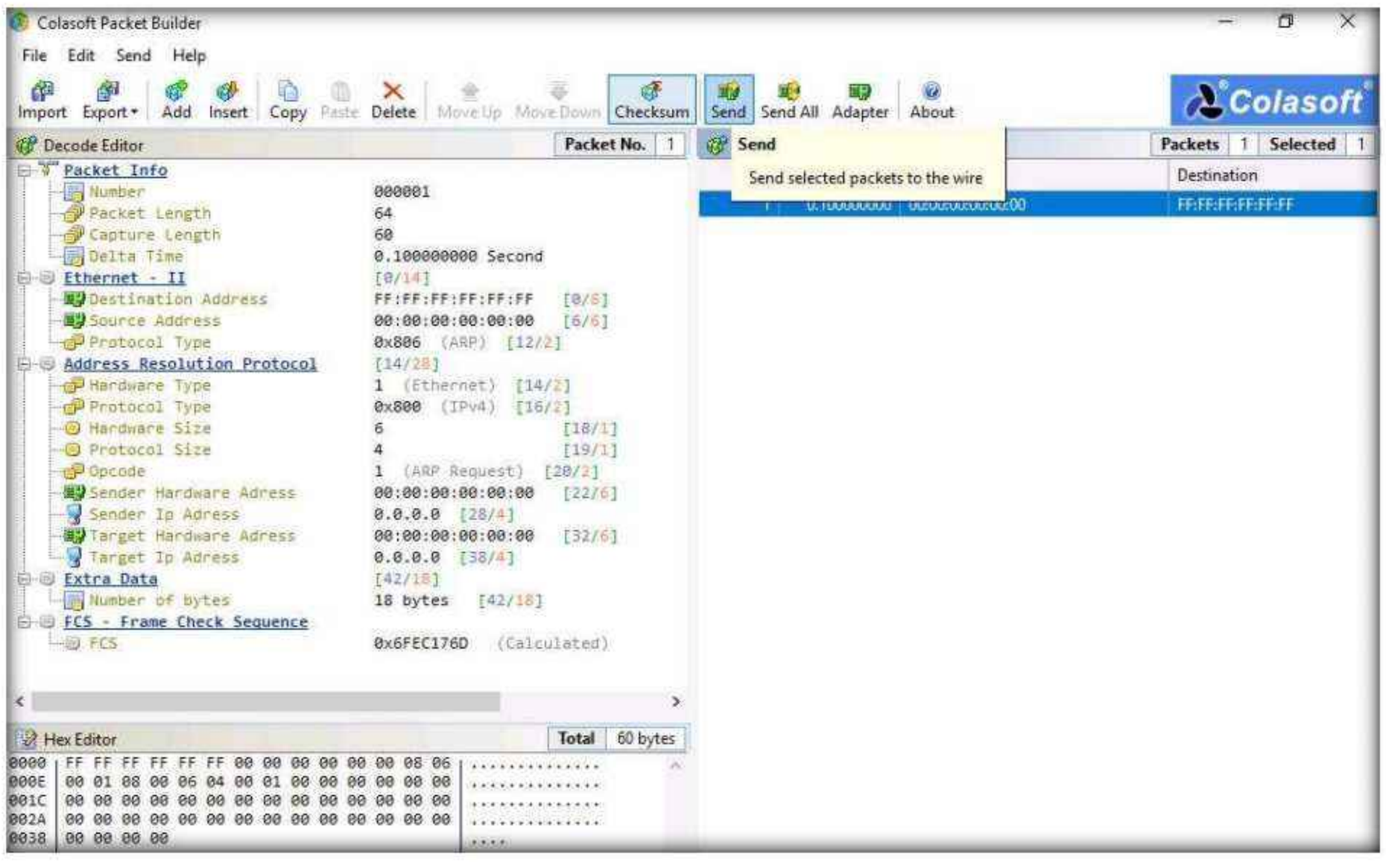


11. **Colasoft Packet Builder** allows you to edit the decoding information in the two editors, **Decode Editor** and **Hex Editor**, located in the left pane of the window.
    - The **Decode Editor** section allows you to edit the packet decoding information by double-clicking the item that you wish to decode.

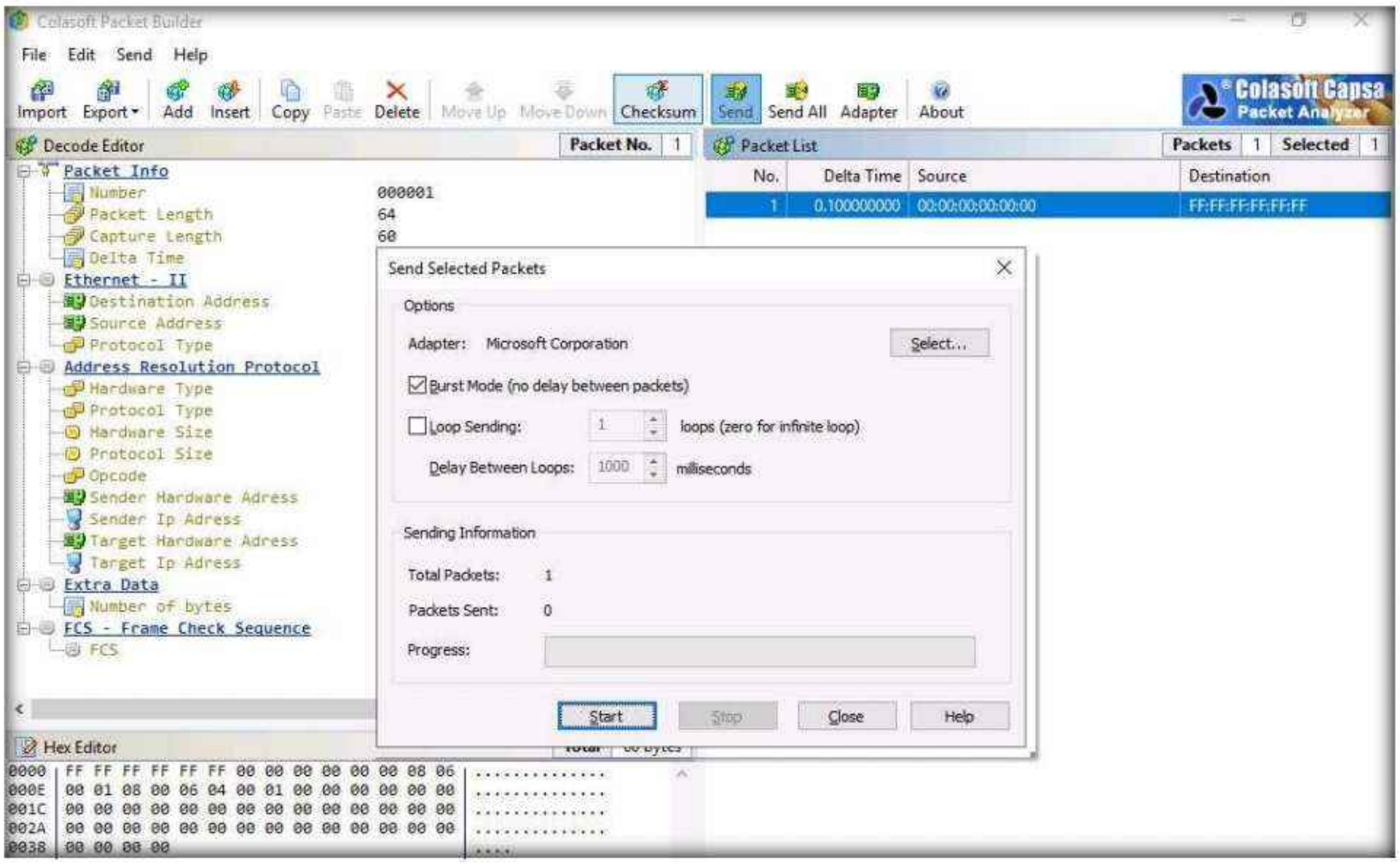
- **Hex Editor** displays the actual packet contents in raw hexadecimal value on the left and its ASCII equivalent on the right.



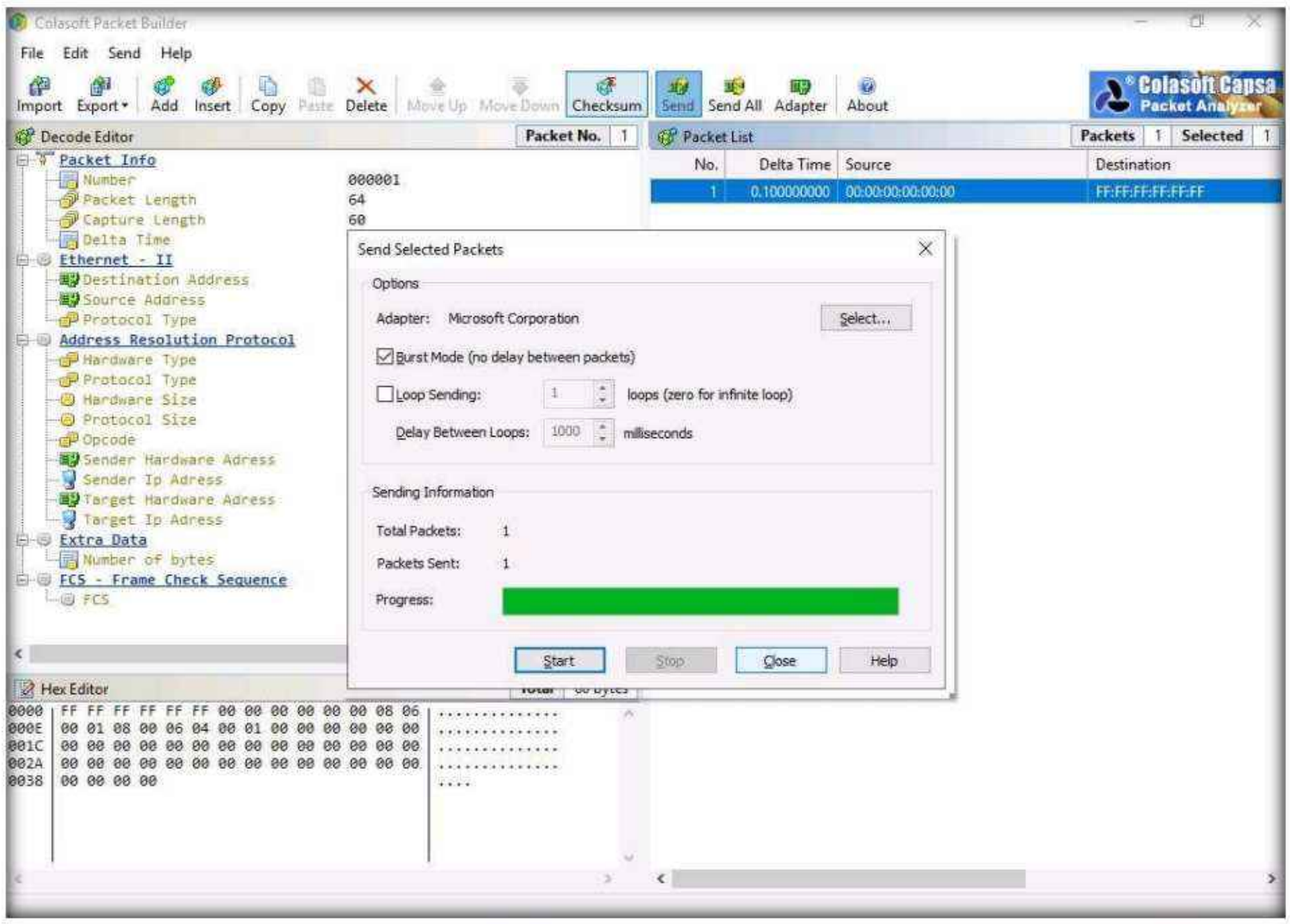
12. To send the packet, click **Send** from the **Menu** bar.



13. In the **Send Selected Packets** window, select the **Burst Mode (no delay between packets)** option, and then click **Start**.



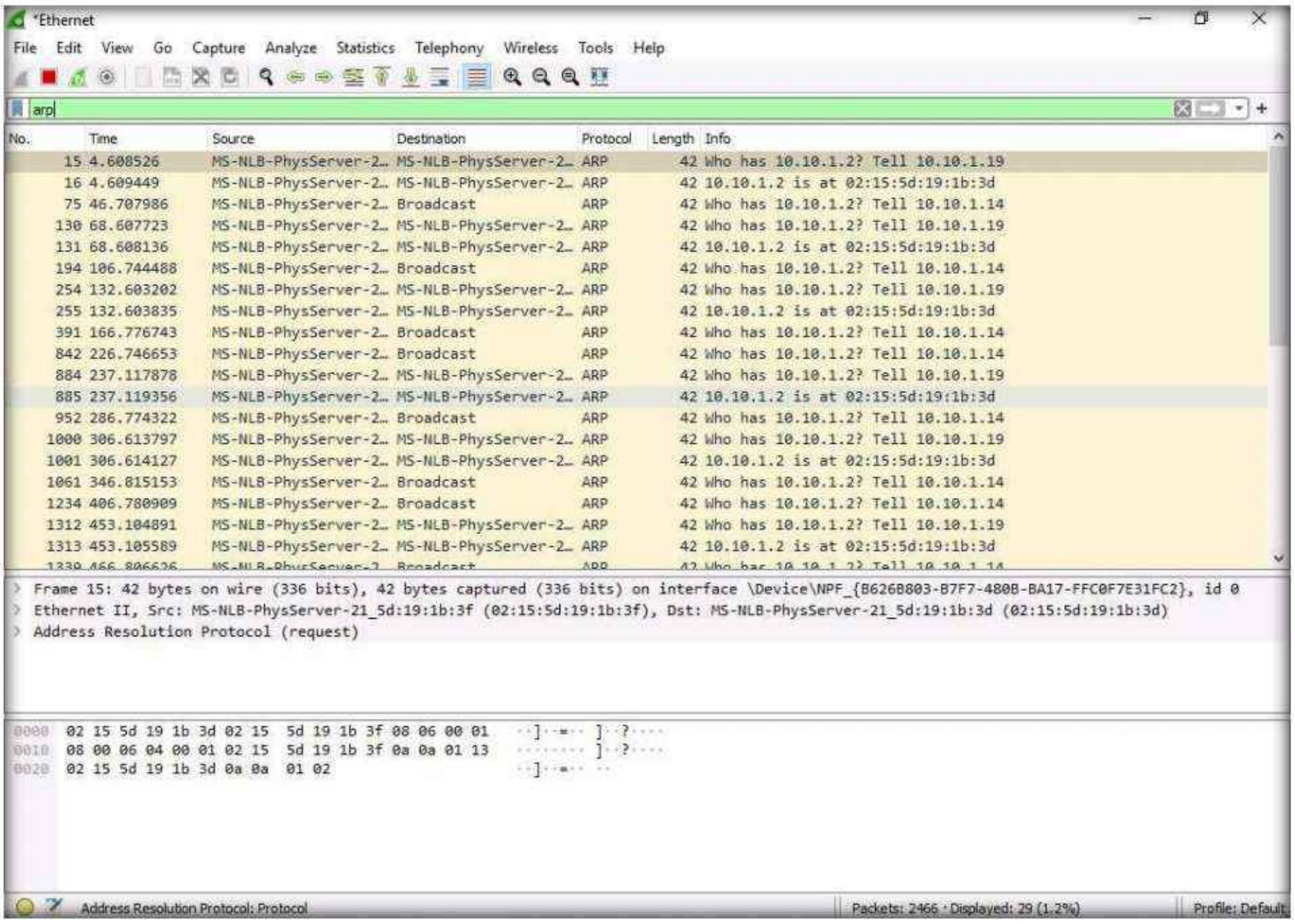
14. After the **Progress** bar completes, click **Close**.



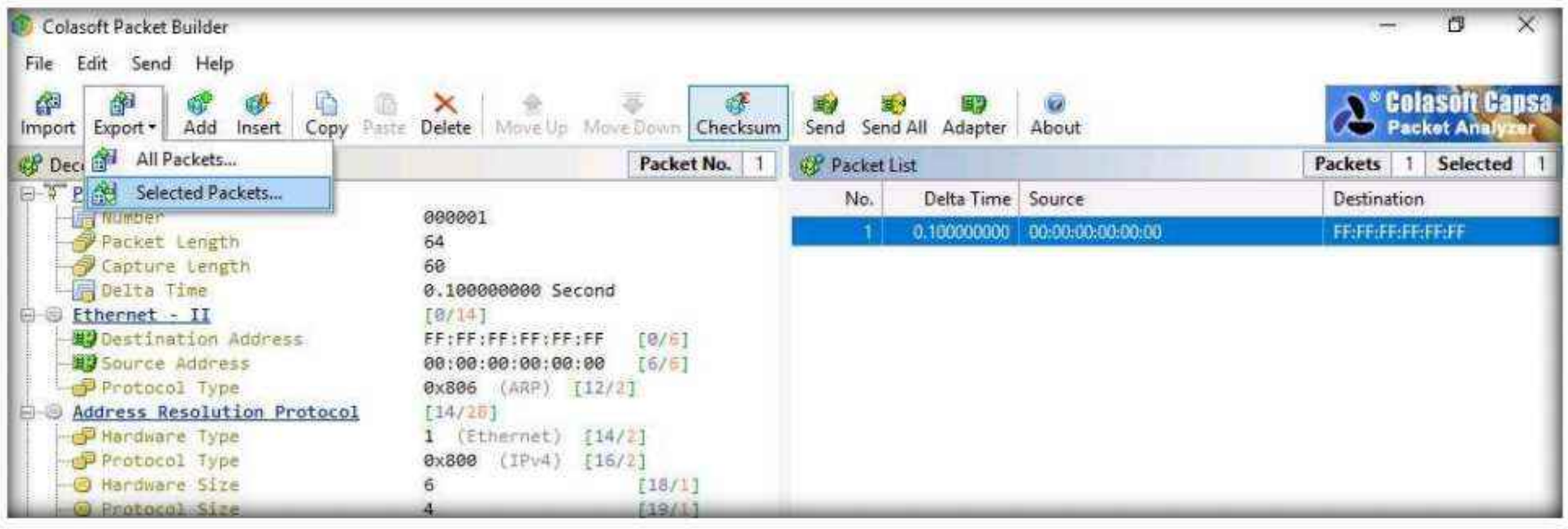
15. Now, when this ARP packet is broadcasted in the network, the active machines receive the packet, and a few start responding with an ARP reply. To evaluate which machine is responding to the ARP packet, you need to observe packets captured by the **Wireshark** tool.

16. In the **Wireshark** window, click on the **Filter** field, type **arp** and press **Enter**. The ARP packets will be displayed, as shown in the screenshot.

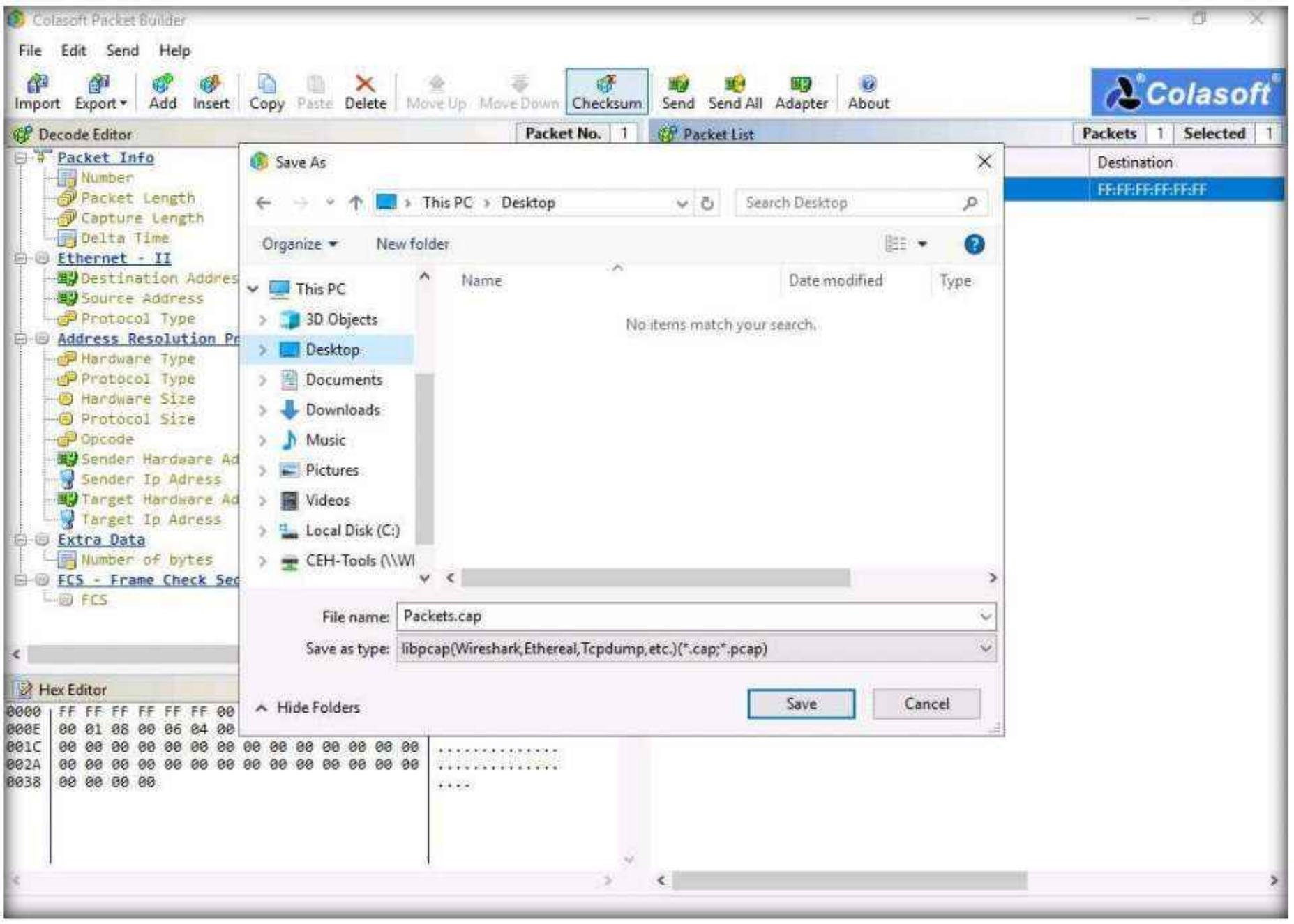
    Note: Here, the host machine (**10.10.1.19**) is broadcasting ARP packets, prompting the target machines to reply to the message.



17. Switch back to the **Colasoft Packet Builder** window, to export the packet, click **Export** → **Selected Packets…**.



18. In the **Save As** window, select a destination folder in the **Save in** field, specify **File name** and **Save as type**, and click **Save**.



19. This saved file can be used for future reference.
20. Attackers can use this packet builder to create fragmented packets to bypass network firewalls and IDS systems. They can also create packets and flood the victim with a very large number of packets, which could result in DoS attacks.
21. This concludes the demonstration of creating a custom TCP packets to scan the target host by bypassing the IDS/firewall.
22. Close all open windows and document all the acquired information.
23. Turn off the **Windows Server 2019** virtual machine.

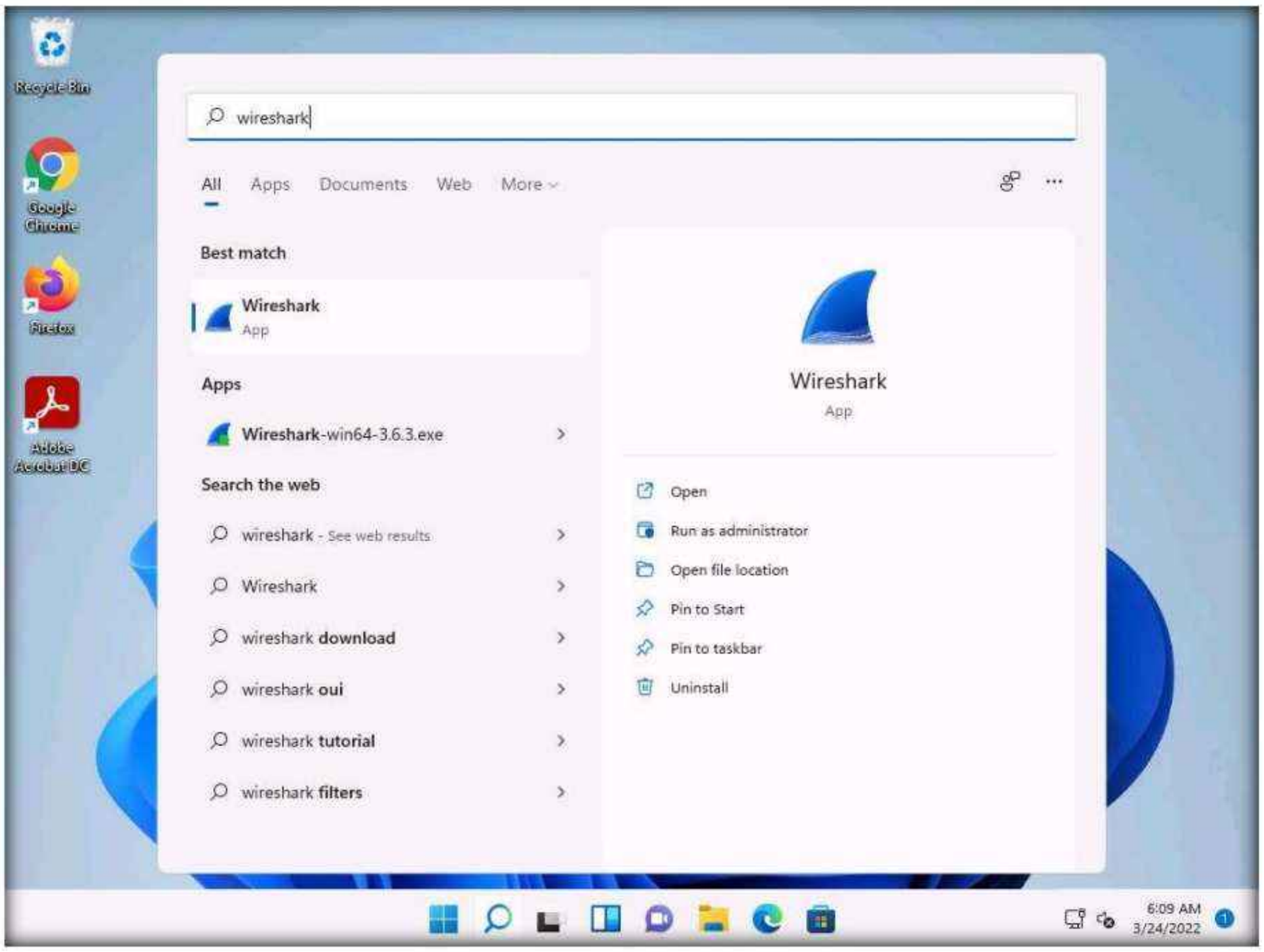
Task 3: Create Custom UDP and TCP Packets using Hping3 to Scan beyond the IDS/Firewall

Hping3 is a scriptable program that uses the TCL language, whereby packets can be received and sent via a binary or string representation describing the packets.

Here, we will use Hping3 to create custom UDP and TCP packets to evade the IDS/firewall in the target network.

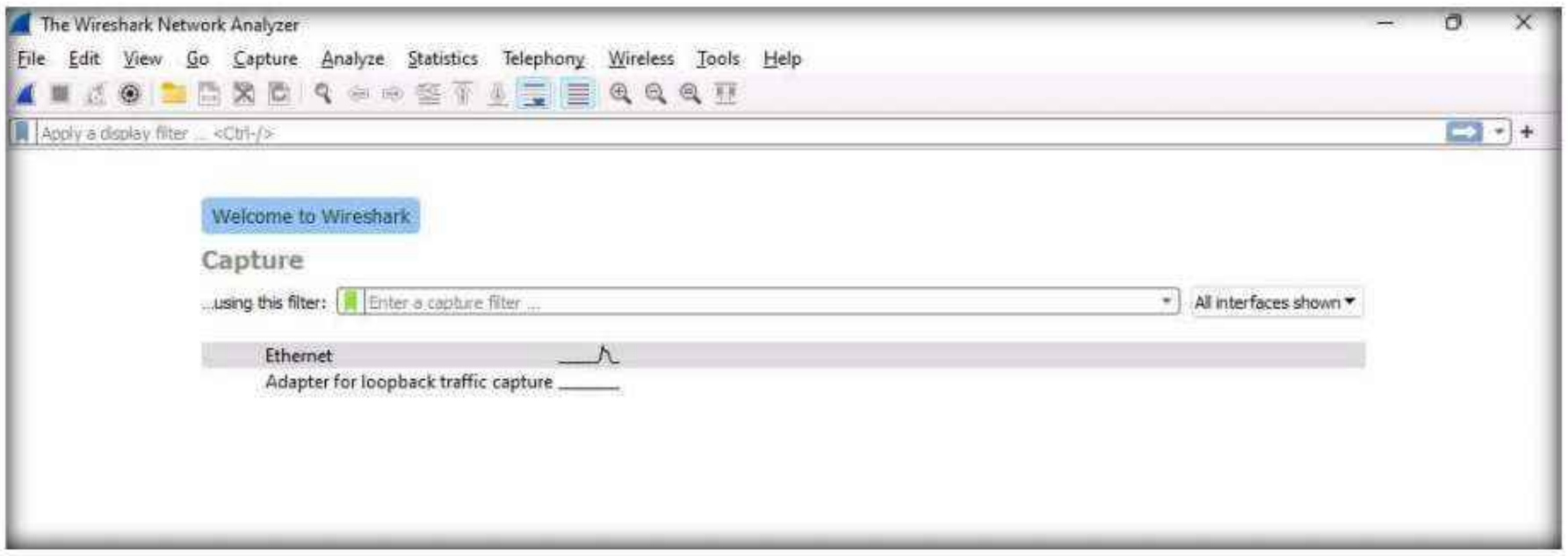
Note: Before beginning this task, ensure that the **Windows Defender Firewall** in the **Windows 11** machine is enabled.

1. Switch to the **Windows 11** virtual machine.
2. Click **Search** icon () on the **Desktop**. Type **wireshark** in the search field, the **Wireshark** appears in the results, click **Open** to launch it.



3. The **Wireshark Network Analyzer** window appears, double-click the available ethernet or interface (here, **Ethernet**) to start the packet capture.

   Note: If a **Software Update** pop-up appears click on **Remind me later**.

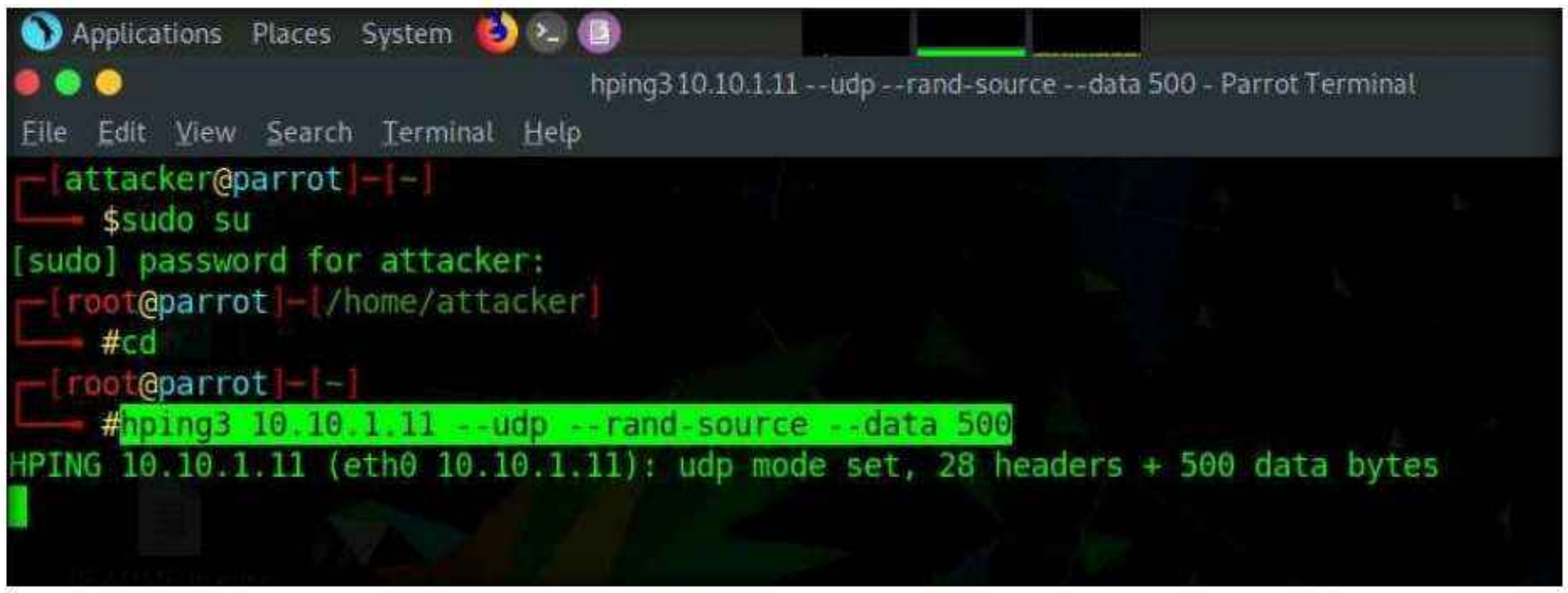


4. Switch to the **Parrot Security** virtual machine.
5. Click the **MATE Terminal** icon in the top-left corner of the **Desktop** to open a **Terminal** window.
6. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
7. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.
8. Now, type **cd** and press **Enter** to jump to the root directory.
9. In the **Parrot Terminal** window, type **hping3 [Target IP Address] --udp --rand-source --data 500** (here, the target machine is **Windows 11** [**10.10.1.11**]) and press **Enter**.

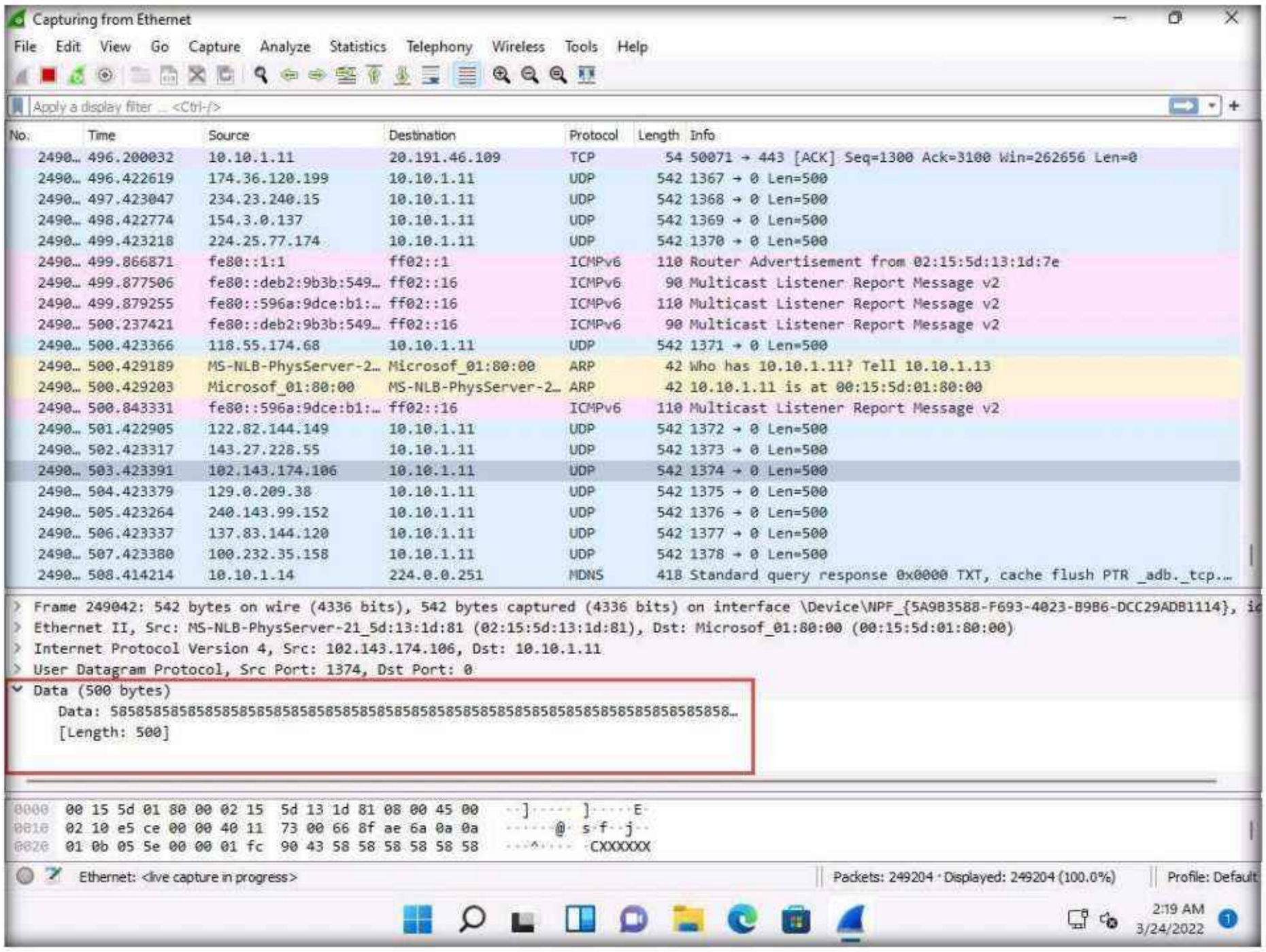
   Note: Here, **--udp** specifies sending the UDP packets to the target host, **--rand-source** enables the random source mode and **--data** specifies the packet body size.

   Note: The MAC addresses might differ when you perform this task.



10. Switch to the **Windows 11** virtual machine and observe the random UDP packets captured by **Wireshark**.

    Note: You can double-click any UDP packet and observe the detail.
11. Expand the **Data** node in the **Packet Details** pane and observe the size of **Data** and its **Length** (the length is the same as the size of the packet body that we specified in Hping3 command, i.e., **500**).

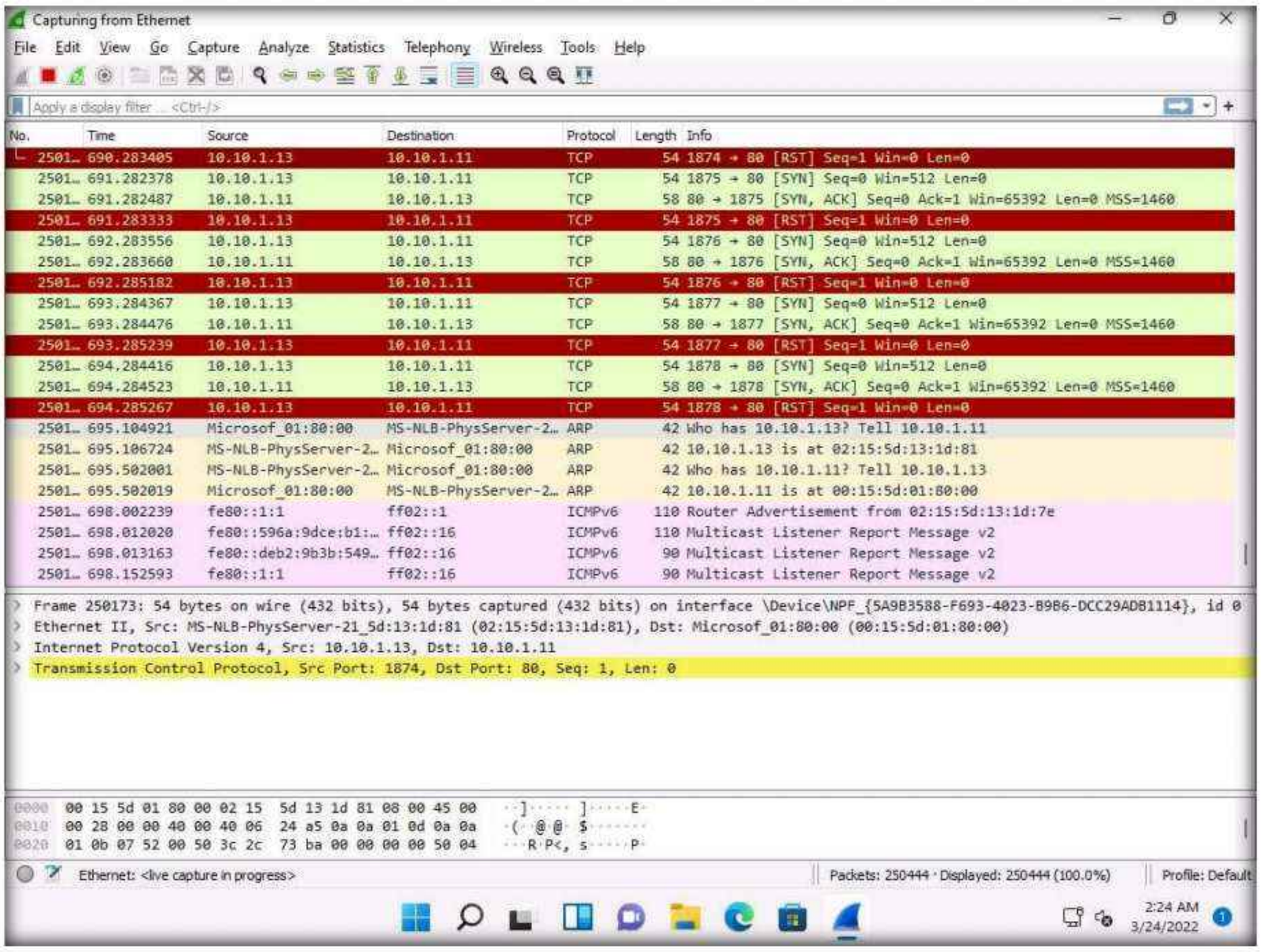


12. Switch to the **Parrot Security** virtual machine. In the **Parrot Terminal** window, first press **Control+C** and type **hping3 -S [Target IP Address] -p 80 -c 5** (here, target IP address is **10.10.1.11**), and then press **Enter**.

    Note: Here, **-S** specifies the TCP SYN request on the target machine, **-p** specifies assigning the port to send the traffic, and **-c** is the count of the packets sent to the target machine.

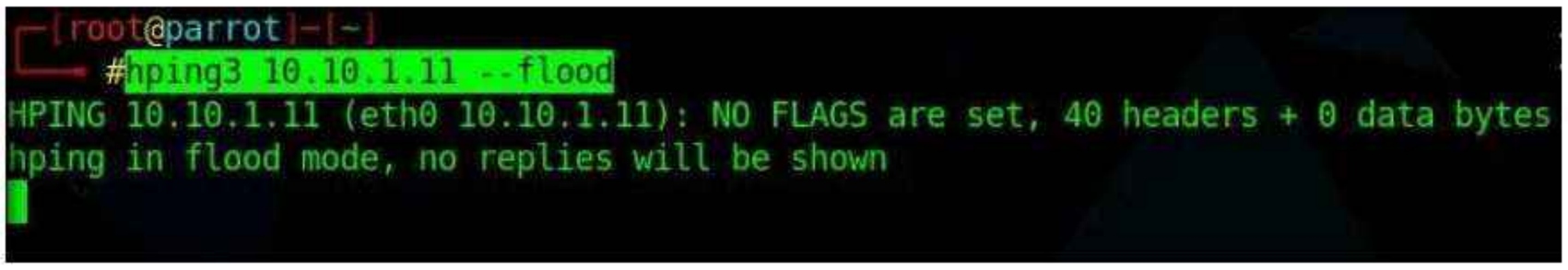
13. In the result, it is indicated that five packets were sent and received through port 80.

14. Switch to the target machine (i.e., **Windows 11**) and observe the TCP packets captured via **Wireshark**.



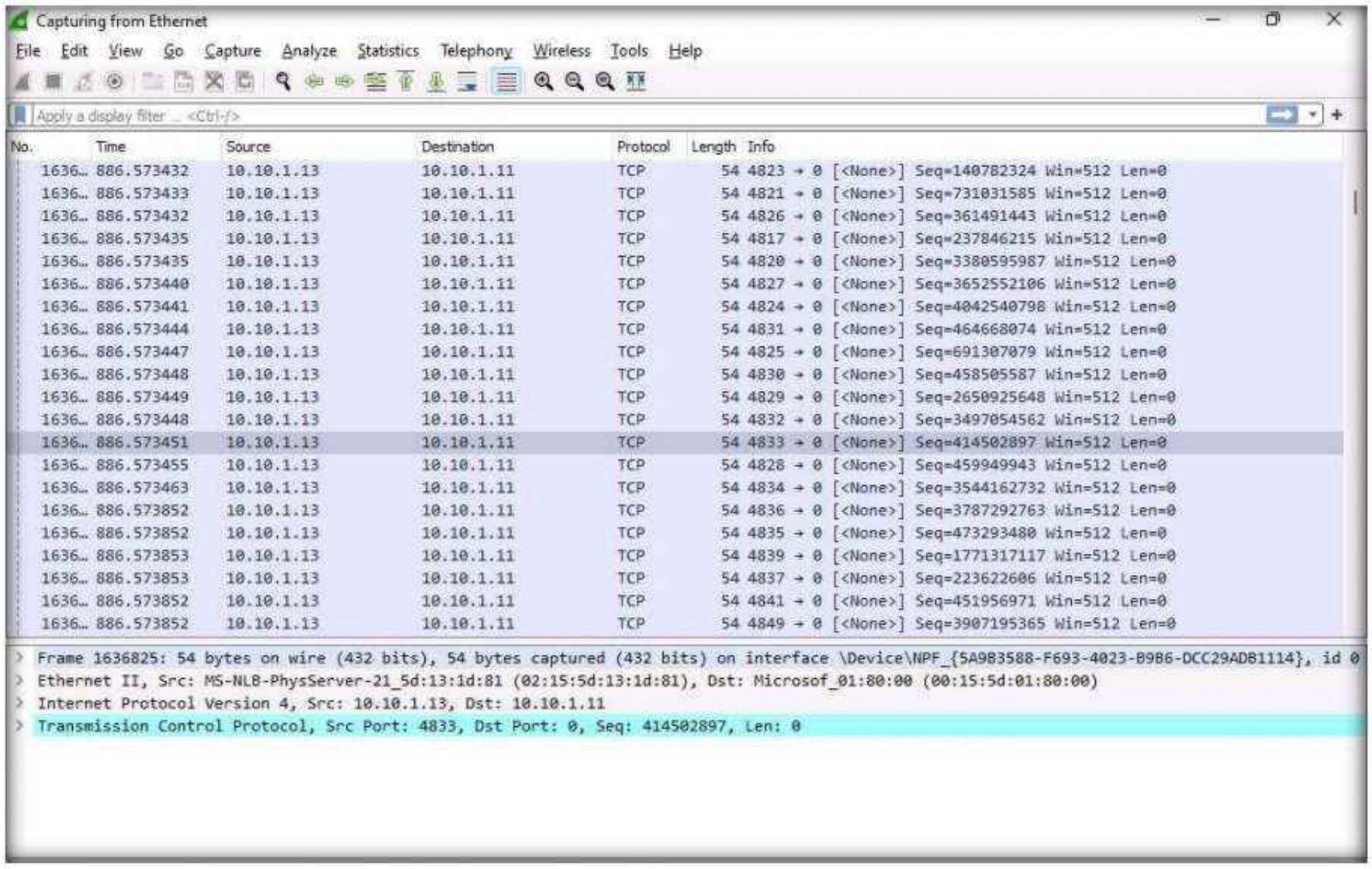
15. Switch to the **Parrot Security** virtual machine and try to flood the target machine (here, **Windows 11**) with TCP packets.
16. In the **Parrot Terminal** window, type **hping3 [Target IP Address] --flood** (here, target IP address is **10.10.1.11**) and press **Enter**.

    Note: **--flood**: performs the TCP flooding.
17. Once you flood traffic to the target machine, it will respond in the hping3 terminal.

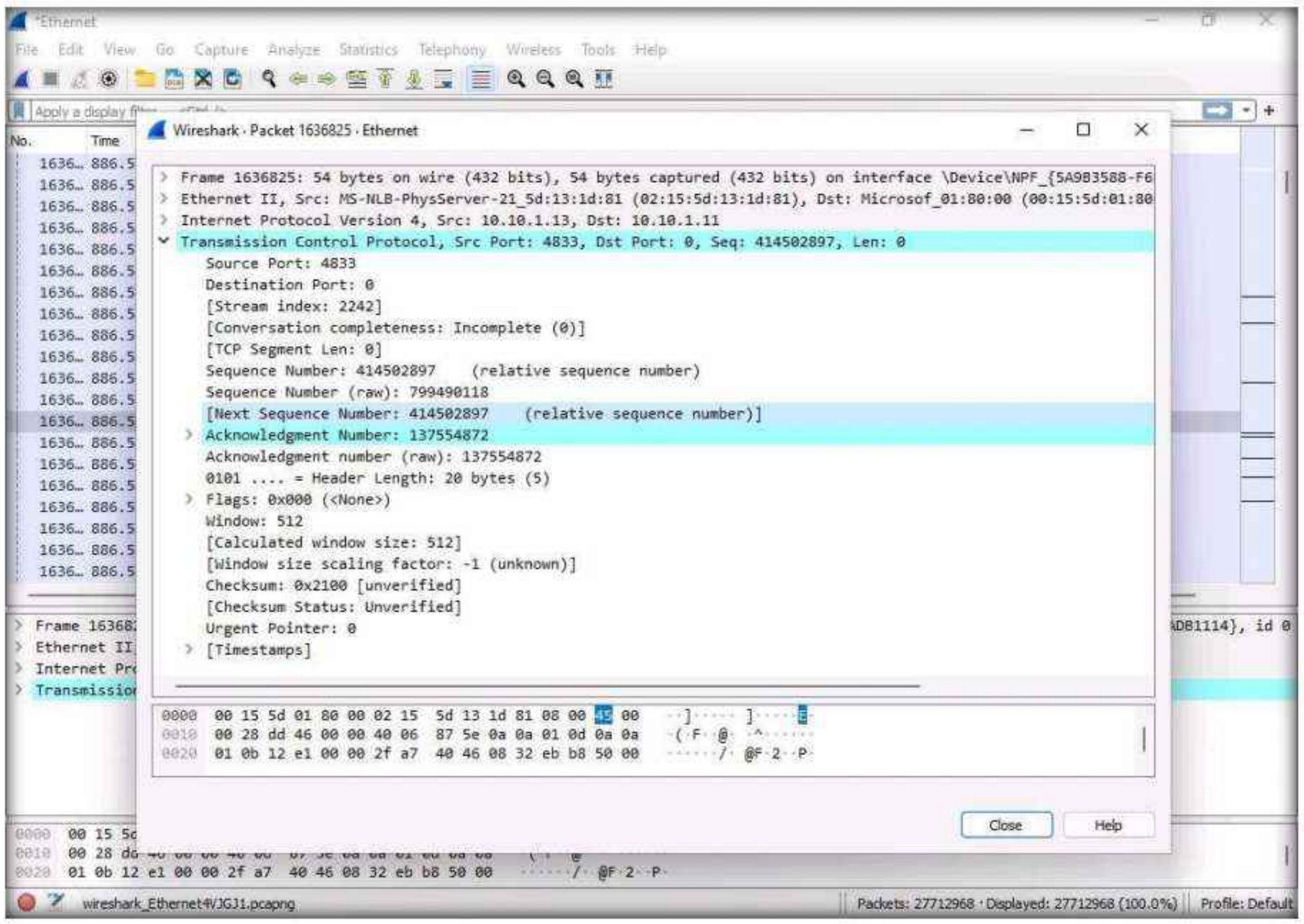


18. Switch to the **Windows 11** (target machine) and stop the packet capture in the **Wireshark** window after a while by click **Stop Capturing Packets** icon in the toolbar.
19. Observe the **Wireshark** window, which displays the TCP packet flooding from the host machine. The attacker employs TCP SYN flooding technique to perform a DoS attack on the target.

Note: You can double-click the TCP packet stream to observe the TCP packet information.



20. The TCP packet stream displays the complete information of TCP packets such as the source and destination of the captured packet, source port, destination port, etc.



21. Turn off the **Windows Firewall** in the **Windows 11** by navigating to **Control Panel → System and Security → Windows Defender Firewall → Turn Windows Defender Firewall on or off**.
22. This concludes the demonstration of evading the IDS and firewall using various evasion techniques in Hping3.
23. You can also use other packet crafting tools such as **NetScanTools Pro** (https://www.netscantools.com), **Colasoft packet builder** (https://www.colasoft.com), etc. to build custom packets to evade security mechanisms.
24. Close all open windows and document all the acquired information.
25. Turn off the **Parrot Security** virtual machine.

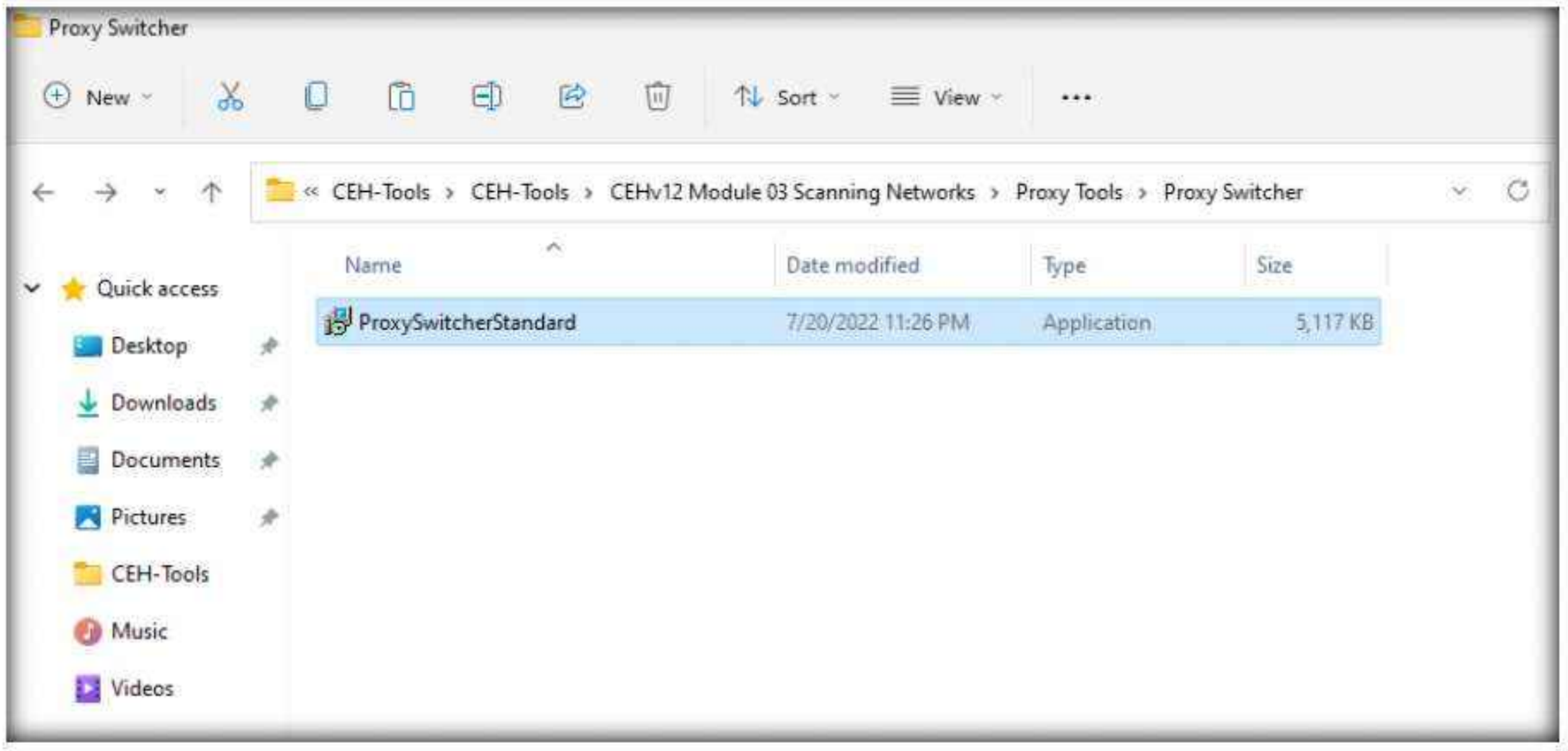
Task 4: Browse Anonymously using Proxy Switcher

Proxy Switcher allows you to surf the Internet anonymously without disclosing the IP address of your system, and helps to access various blocked sites in the organization. It avoids all types of limitations imposed by target sites.

Here, we will use Proxy Switcher to browse the Internet anonymously.

1. In the **Windows 11** virtual machine, navigate to **E:\CEH-Tools\CEHv12 Module 03 Scanning Networks\Proxy Tools\Proxy Switcher and double-click ProxySwitcherStandard.exe**.

Note: If a **User Account Control** window appears, click **Yes**.

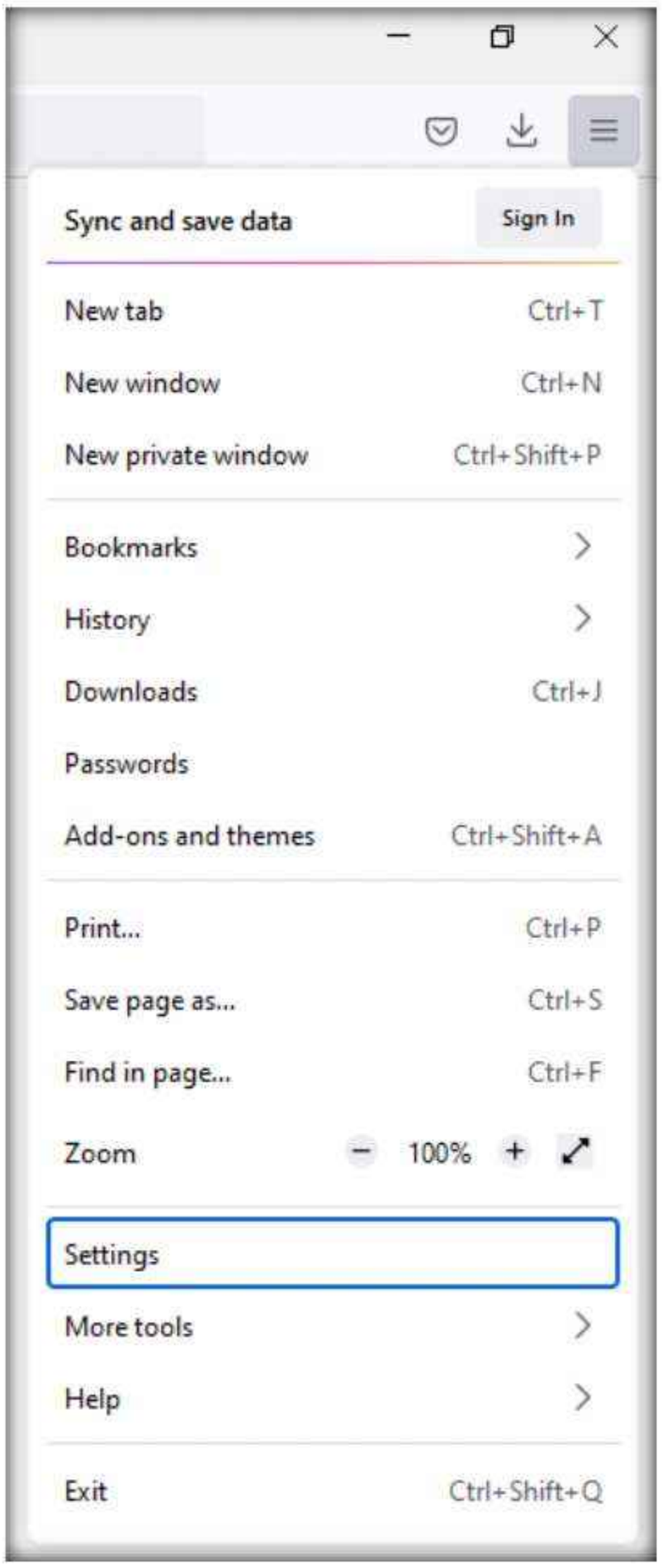


2. Follow the installation steps to install **Proxy Switcher** using all default settings.
3. Once the installation is complete, uncheck all options in the final step of the wizard, and click **Finish**.

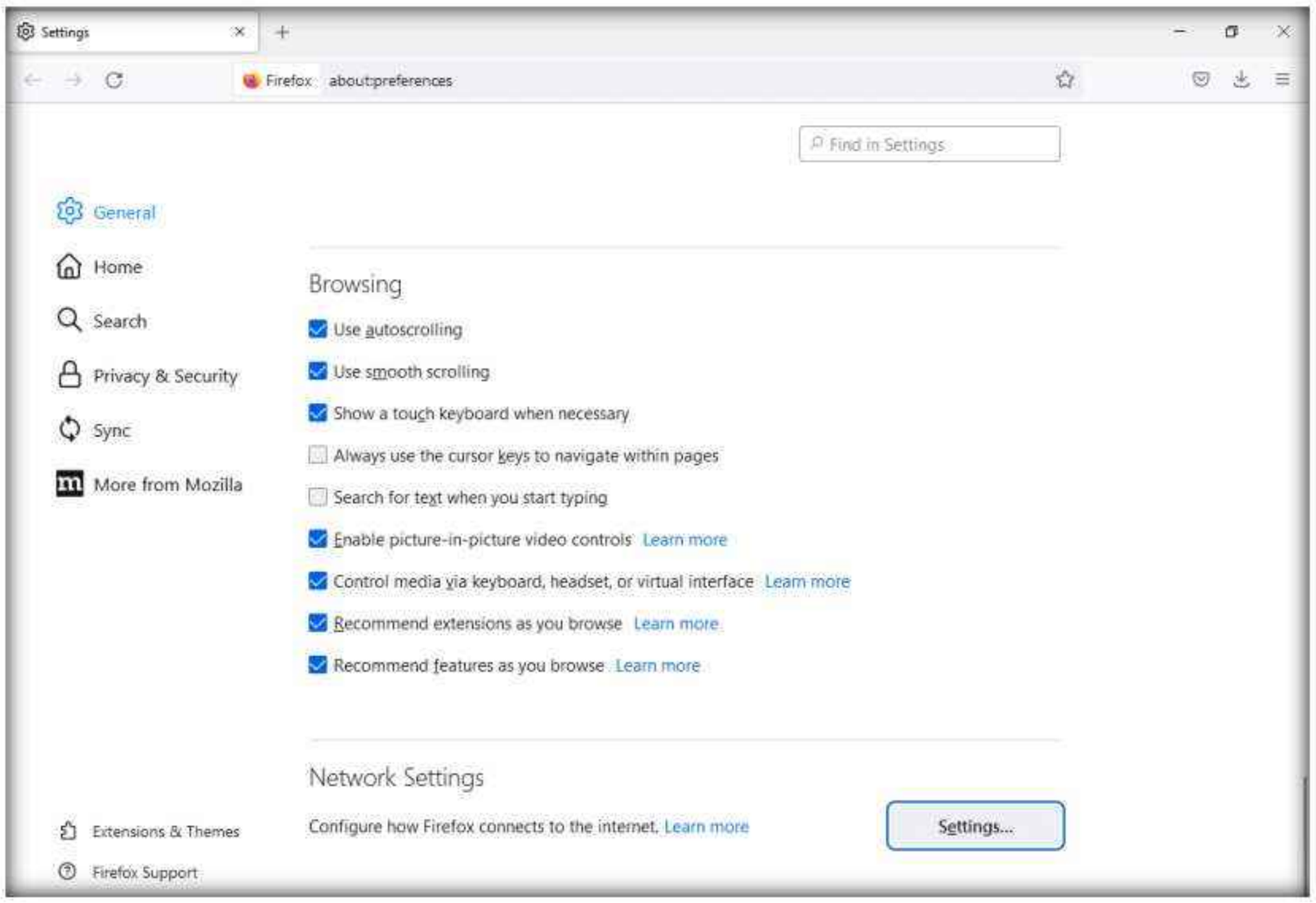
4. Now, launch the **Firefox** browser.

   Note: If a **Default Browser** pop-up appears, click **Not now**.

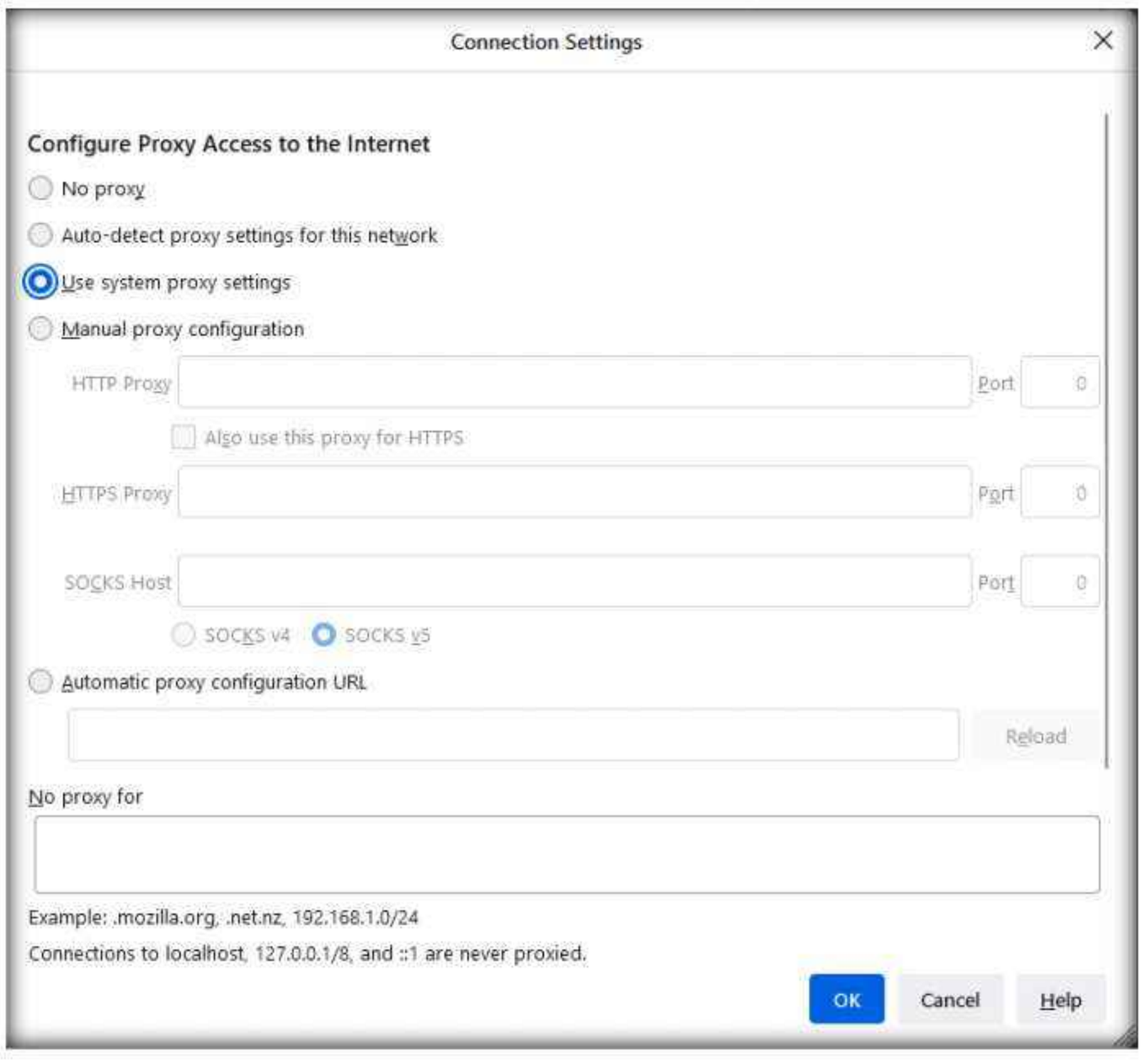
5. Click the **Open menu** icon in the top-right corner of the browser window and click **Settings**.



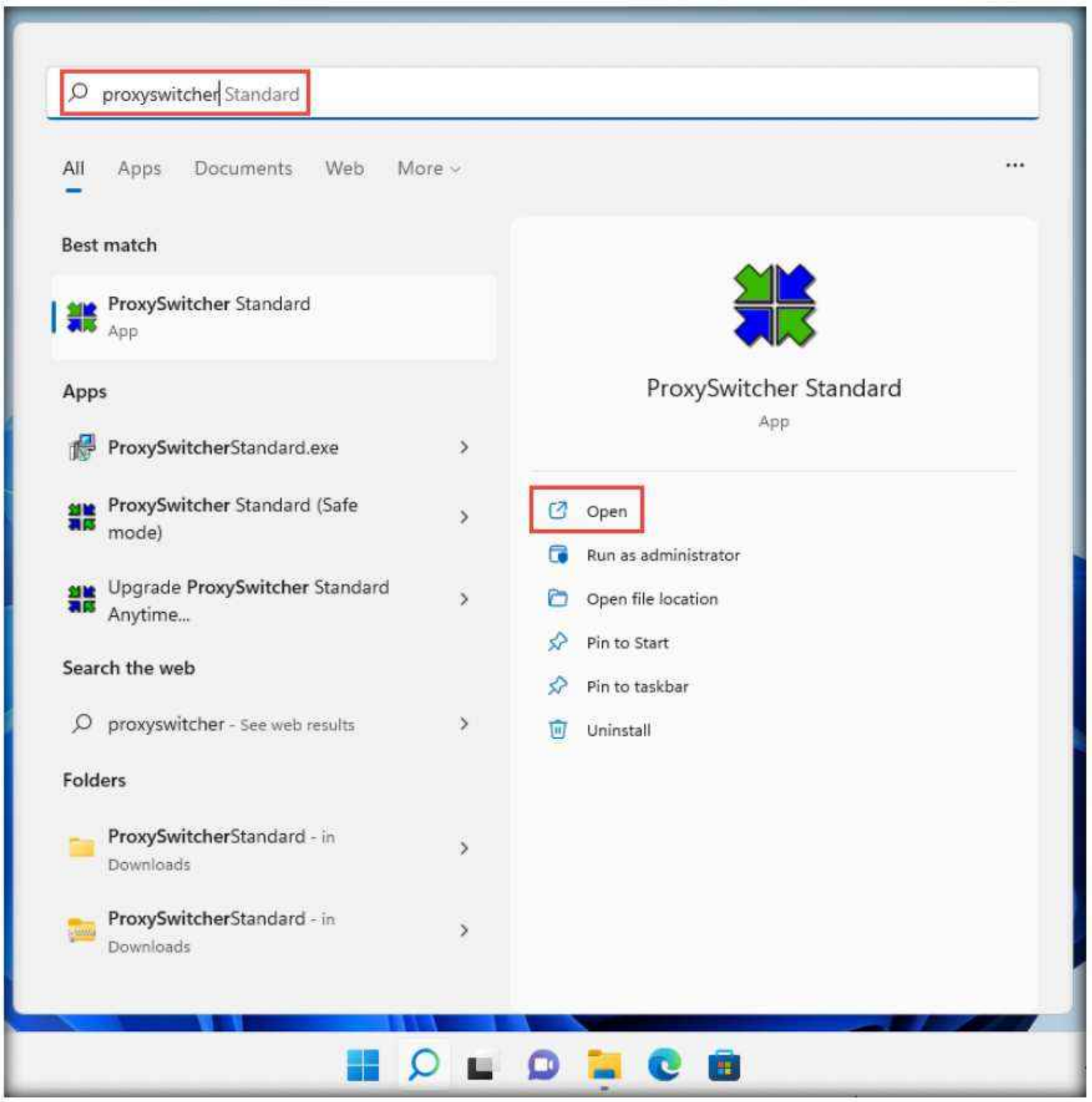
6. In the **Settings** wizard, scroll down to the end of the page and click **Settings...** under the **Network Settings** section.



7. The **Connection Settings** window appears; under the **Configure Proxy Access to the Internet** section, ensure that the **Use system proxy settings** radio button is selected. Click **OK** and close the **Firefox** browser window.

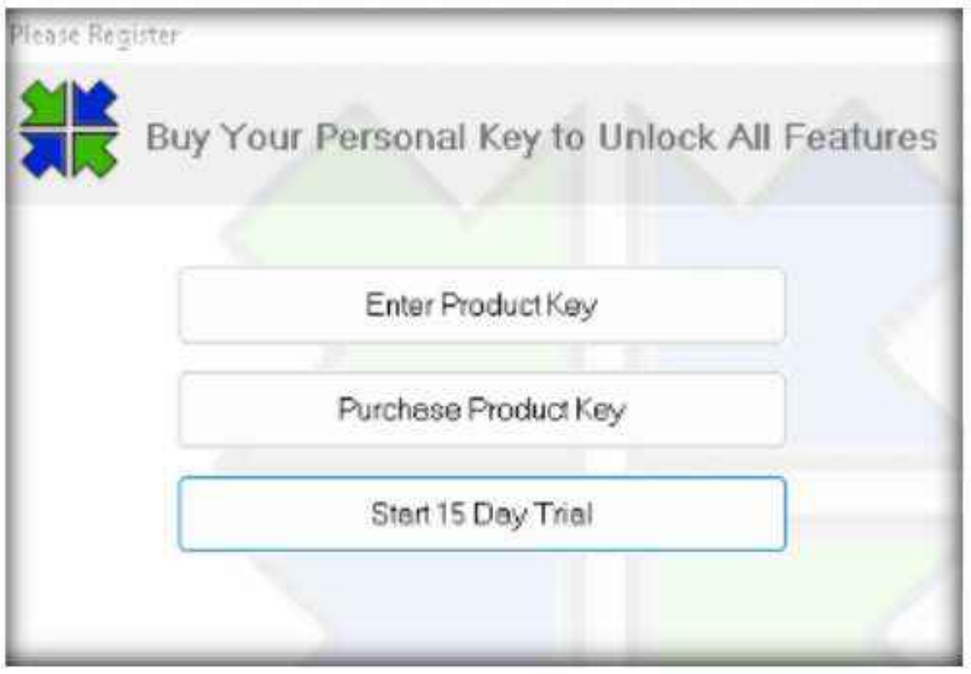


8. Click **Search** icon ( ) on the **Desktop**. Type **proxyswitcher** in the search field, the **ProxySwitcher Standard** appears in the result, click **open** to launch it.

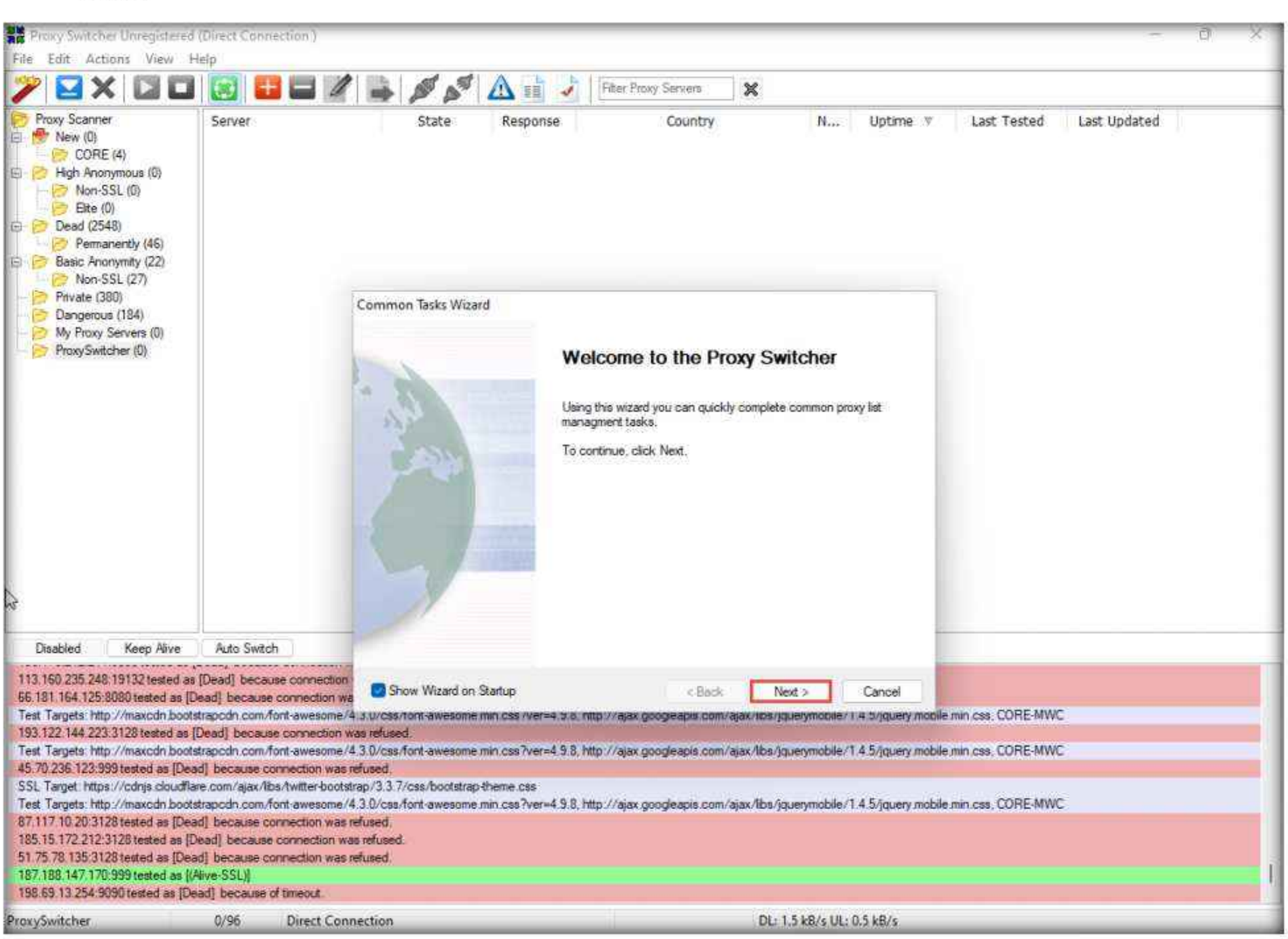


9. The **ProxySwitcher Standard** loads, and its icon appears on **Taskbar**.
10. Click the **Taskbar** icon in the bottom-right corner of the desktop and the click **ProxySwitcher Standard** icon to launch the application.

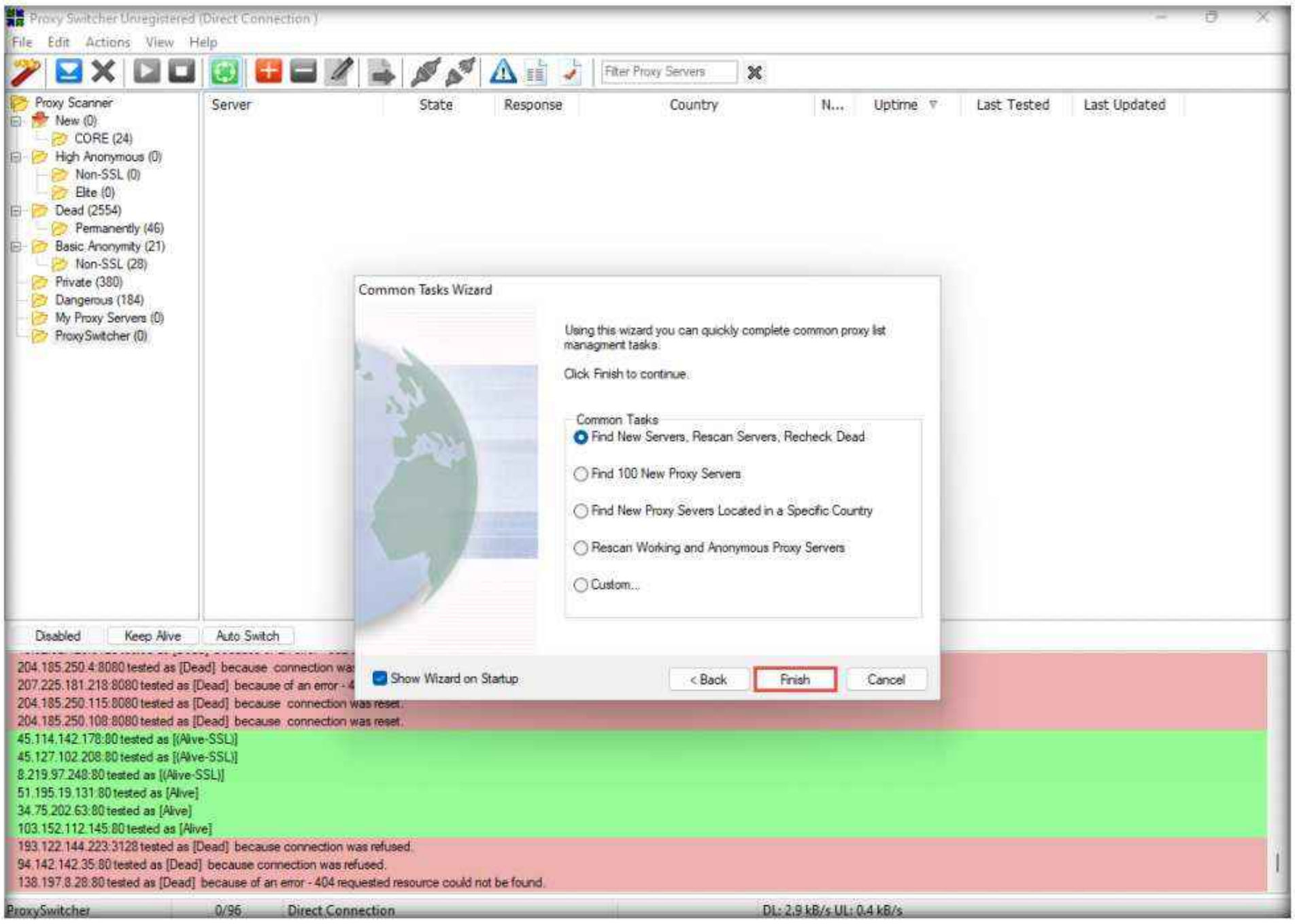
11. The **Please Register** window appears; click the **Start 15 Day Trial** button to proceed.



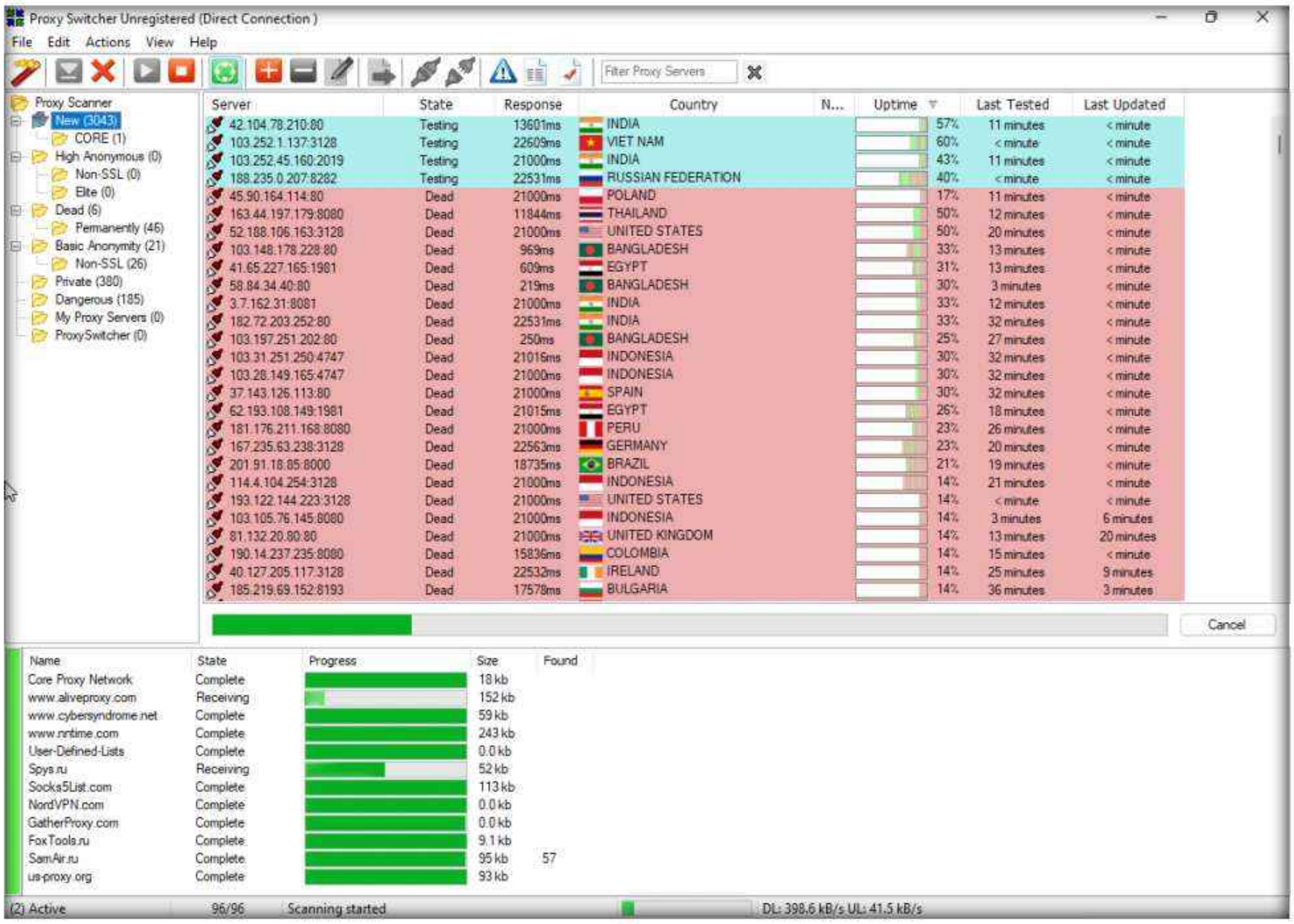
12. The **Common Tasks Wizard** window appears; under **Welcome to the Proxy Switcher**, click **Next**.



13. Ensure that the **Find New Server, Rescan Servers, Recheck Dead** radio button is selected under the **Common Tasks** section, and click **Finish**.



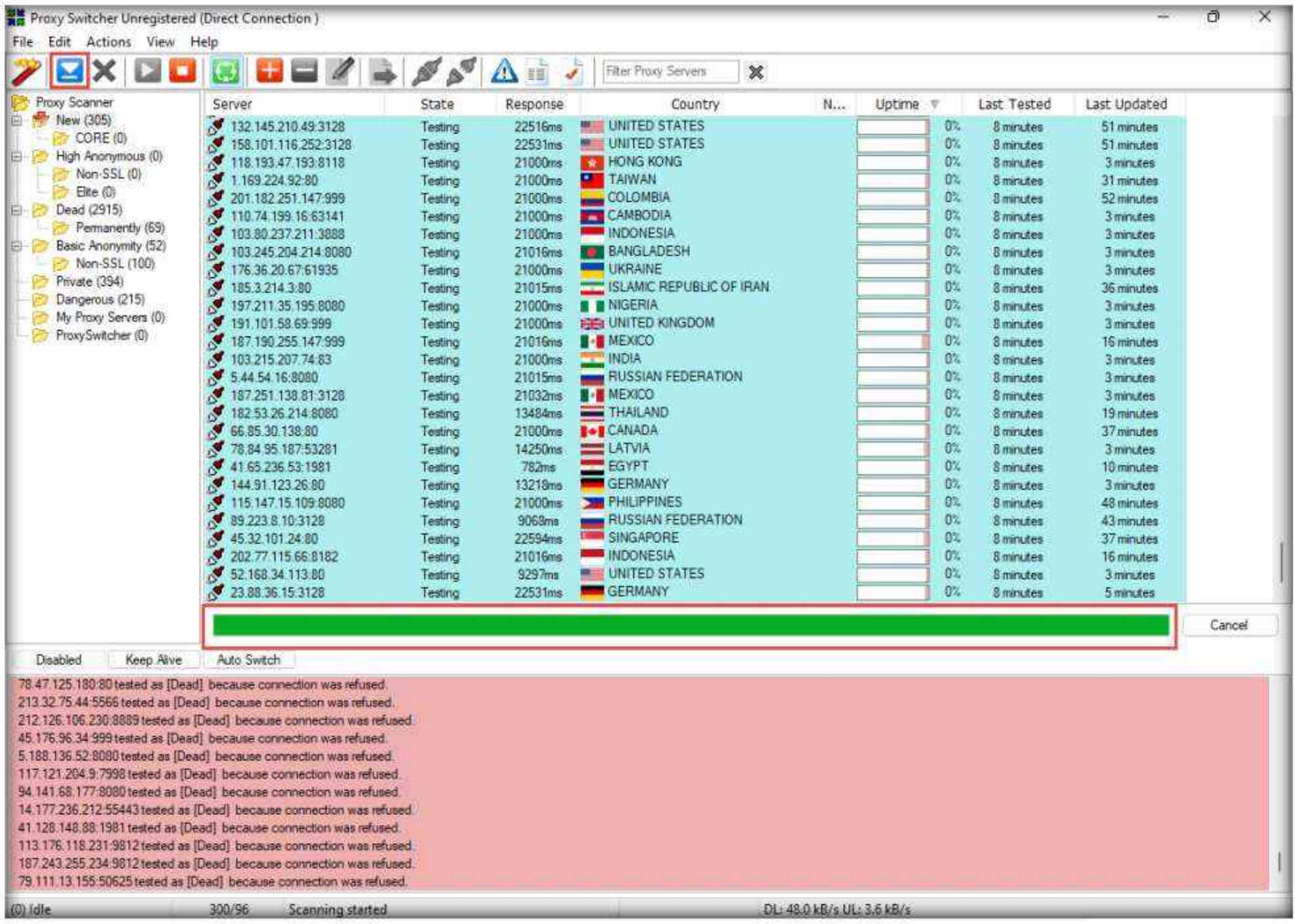
14. **Proxy Switcher** window appears, showing a list of proxy servers in the right pane, as shown in the following screenshot.



Note: The list of proxy servers might vary in your lab environment.

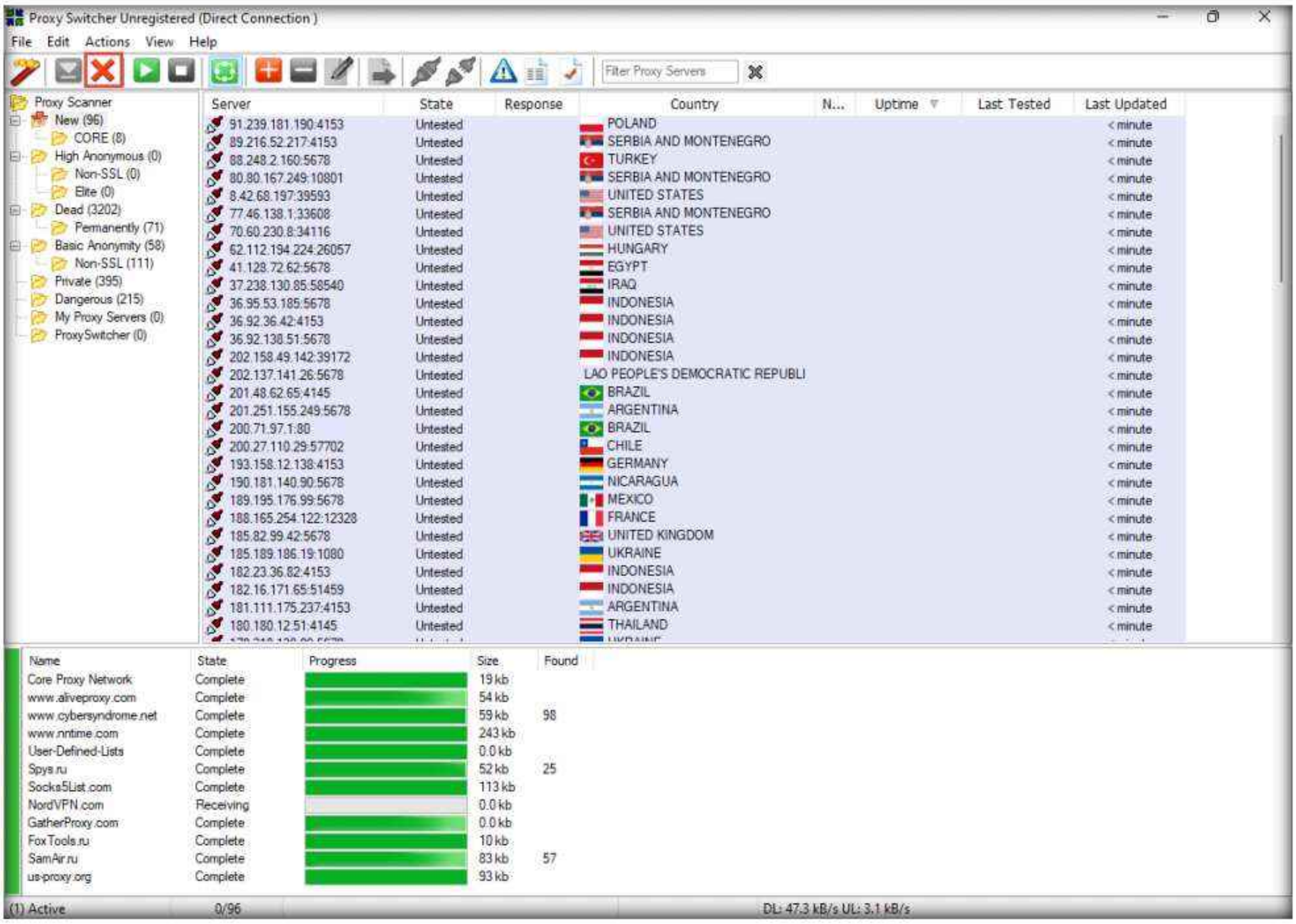
Note: It takes some time for the list to load

15. Observe the search bar below the server section; once it is completed, click the **Download Proxy Lists** icon ( ) to download the proxy list.

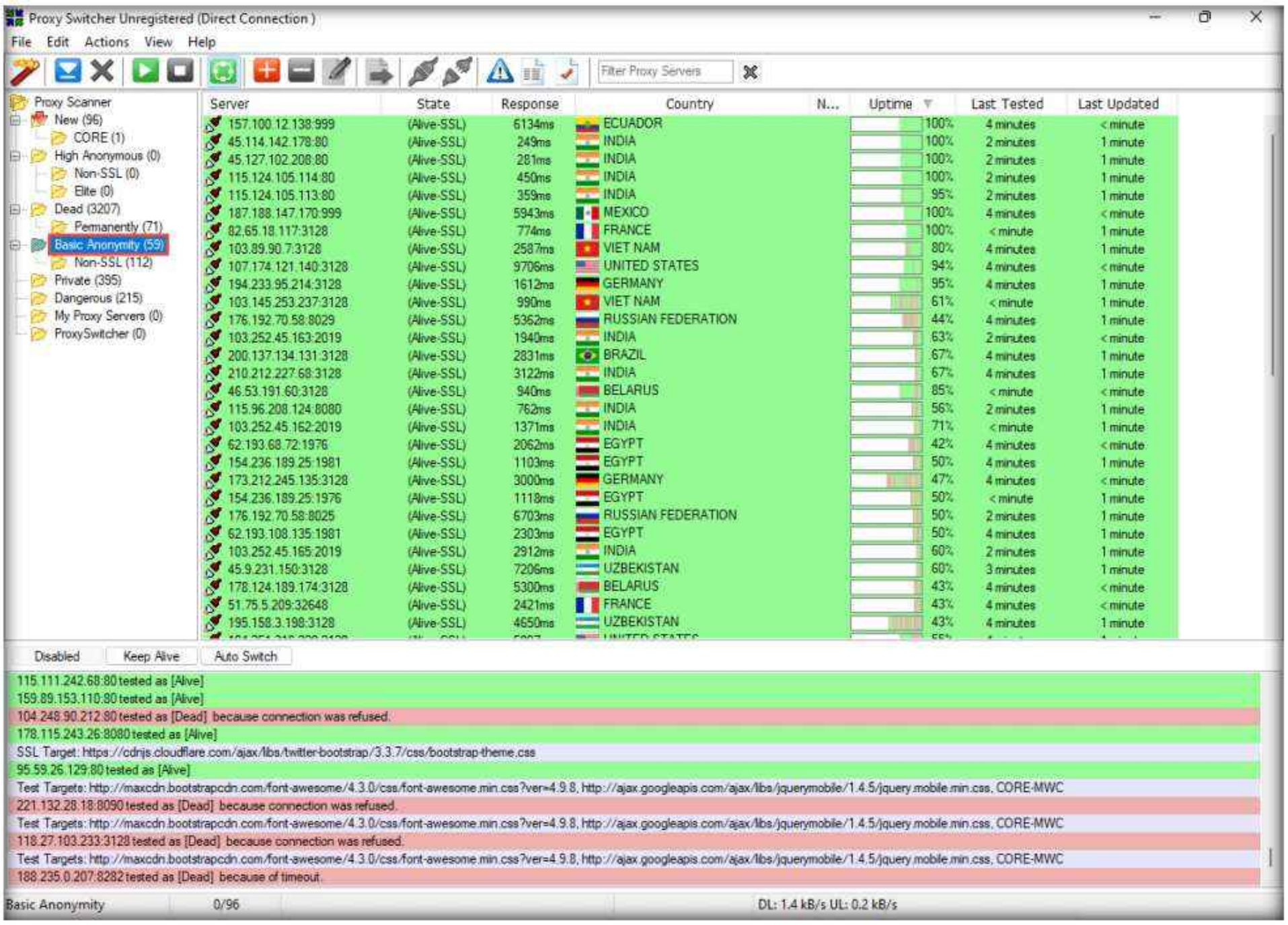


16. Wait until all the proxy servers are downloaded. This can take a significant amount of time.

17. If you have enough downloaded proxy servers, you can click the **Stop Download** ( ) icon to cancel the download.



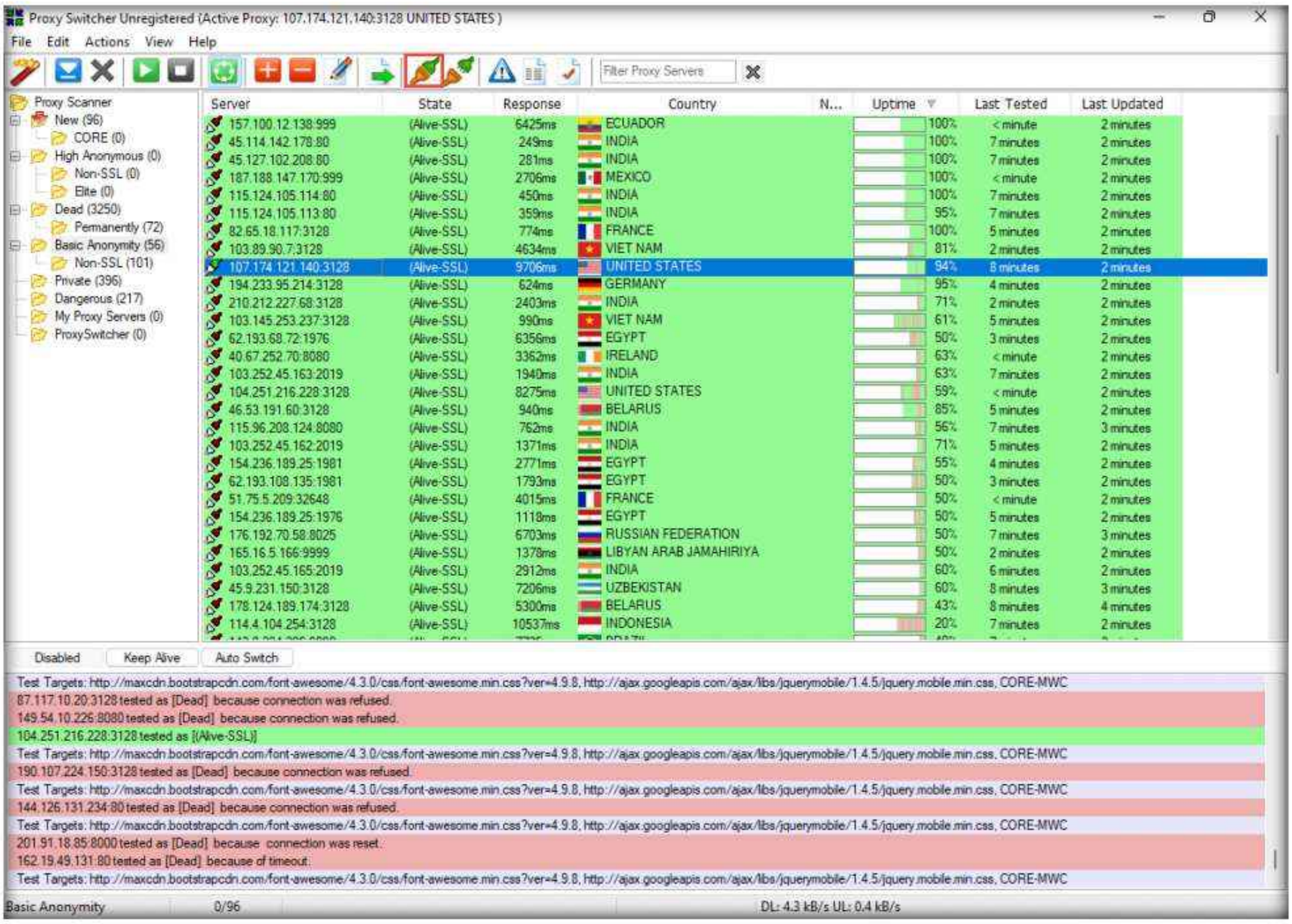
18. Click the **Basic Anonymity** folder in the left-hand pane to display a list of alive proxy servers, as shown in the screenshot.



19. Select one proxy server IP address in the right-hand pane. To switch to the selected proxy server, click the **Switch to Selected Proxy Server** ( ) icon.

20. When the proxy server is connected, it will show the connection icon as .

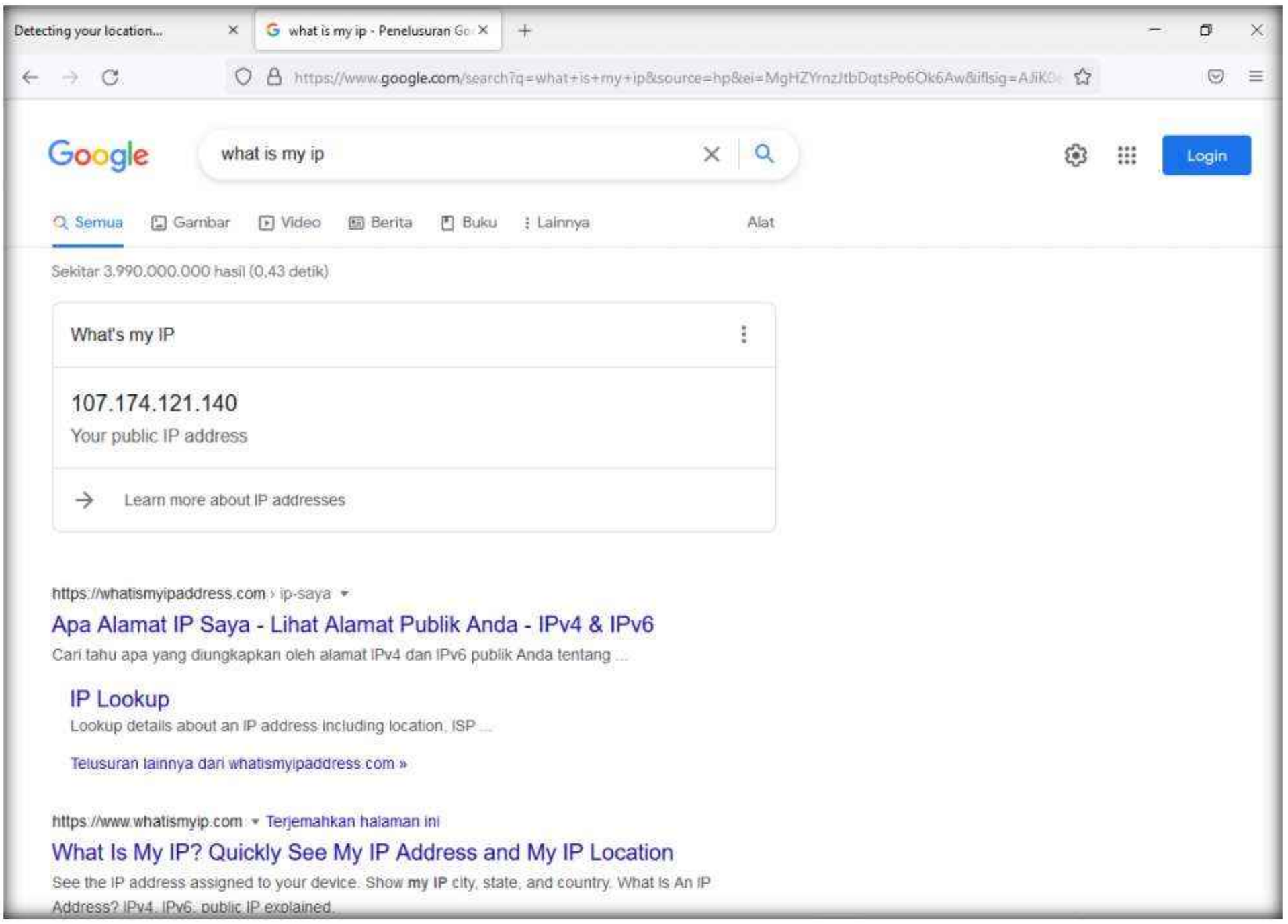
Note: The proxy selected in this lab might vary in your lab **environment**.



21. Launch the **Mozilla Firefox** web browser and enter the URL **http://www.proxyswitcher.com/check.php** to check the selected proxy-server connectivity. If the connection is successful, the following information is displayed in the browser:

Note: The information displayed above may differ in your lab environment.

22. If the connection is unsuccessful, try selecting another proxy from **Proxy Switcher**, and repeat **Step 19**.
23. To ensure that the proxy is assigned, open a new tab and browse **https://www.google.com/**. In the search field, type **What is my ip** and press **Enter**.
24. If **About this page** webpage appears, check **I'm not a robot** checkbox and verify the CAPTCHA by selecting images as per the given guidelines.
25. The proxy IP address is displayed, which infers that the legitimate address is masked, and the proxy is in use.



Note: The displayed IP address might differ in your lab environment.

26. Open a new tab in your web browser and surf anonymously using this proxy.

27. This concludes the demonstration of anonymously surfing the Internet using Proxy Switcher.
28. Close all open windows and document all the acquired information.
29. Navigate to **Control Panel → Programs → Programs and Features** and uninstall the **Proxy Switcher** application.

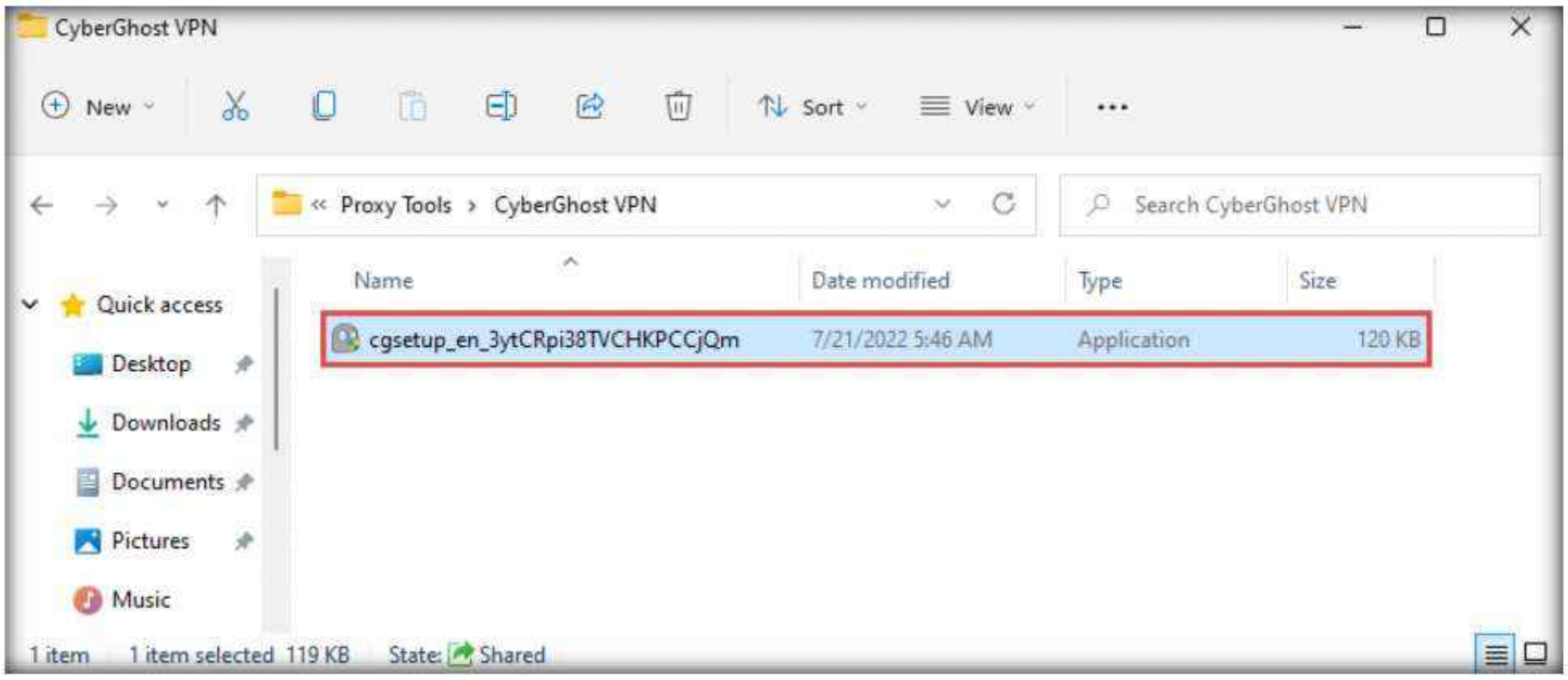
Task 5: Browse Anonymously using CyberGhost VPN

CyberGhost VPN hides the attacker's IP and replaces it with a selected IP, allowing him or her to surf anonymously and access blocked or censored content. It encrypts the connection and does not keep logs, thus securing data.

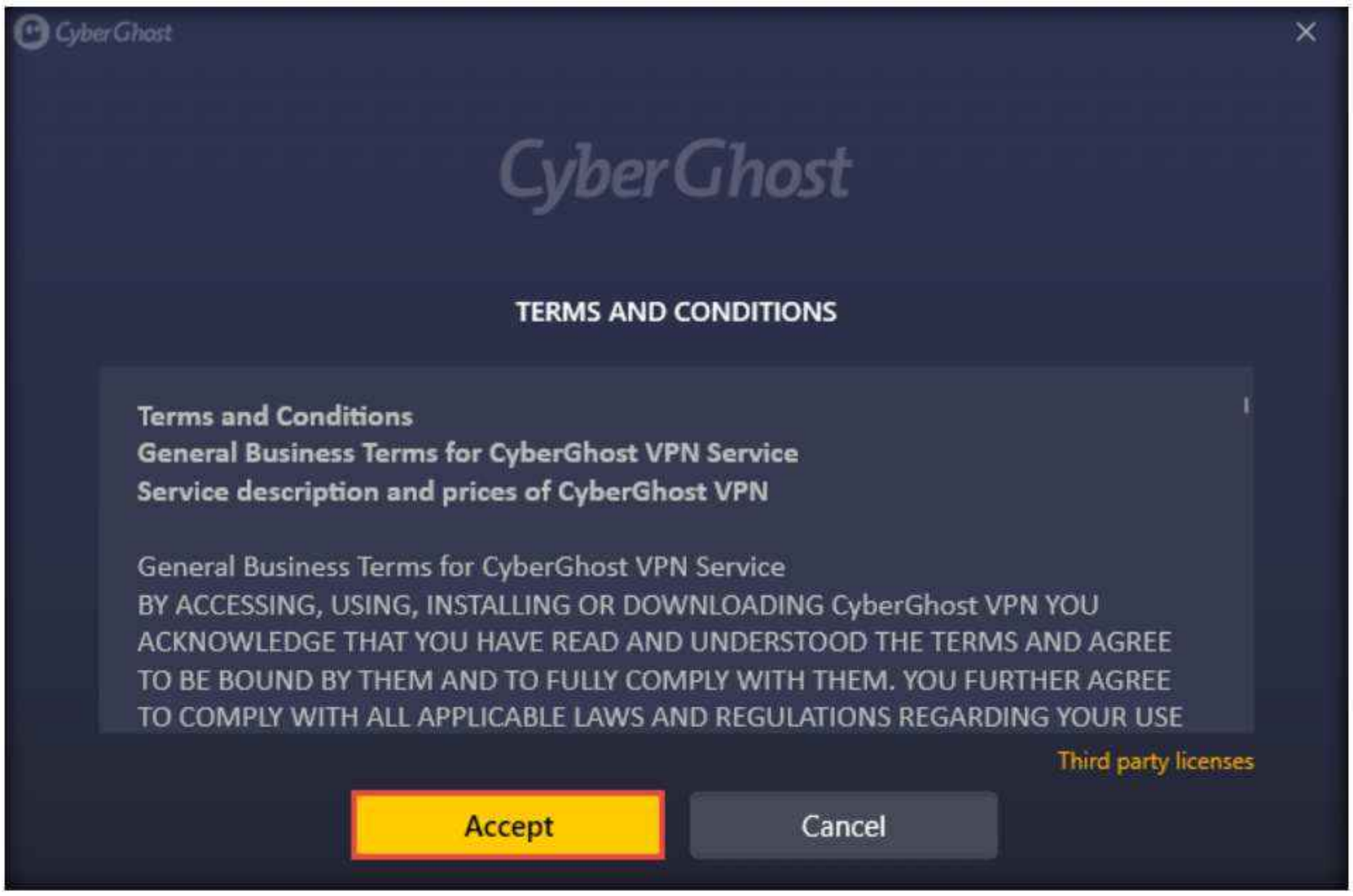
Here, we will use CyberGhost VPN to browse the Internet anonymously.

1. In the **Windows 11** virtual machine, navigate to **E:\CEH-Tools\CEHv12 Module 03 Scanning Networks\Proxy Tools\CyberGhost VPN and double-click cgsetup_en_3ytCRpi38TVCHKPCCQm.exe**.

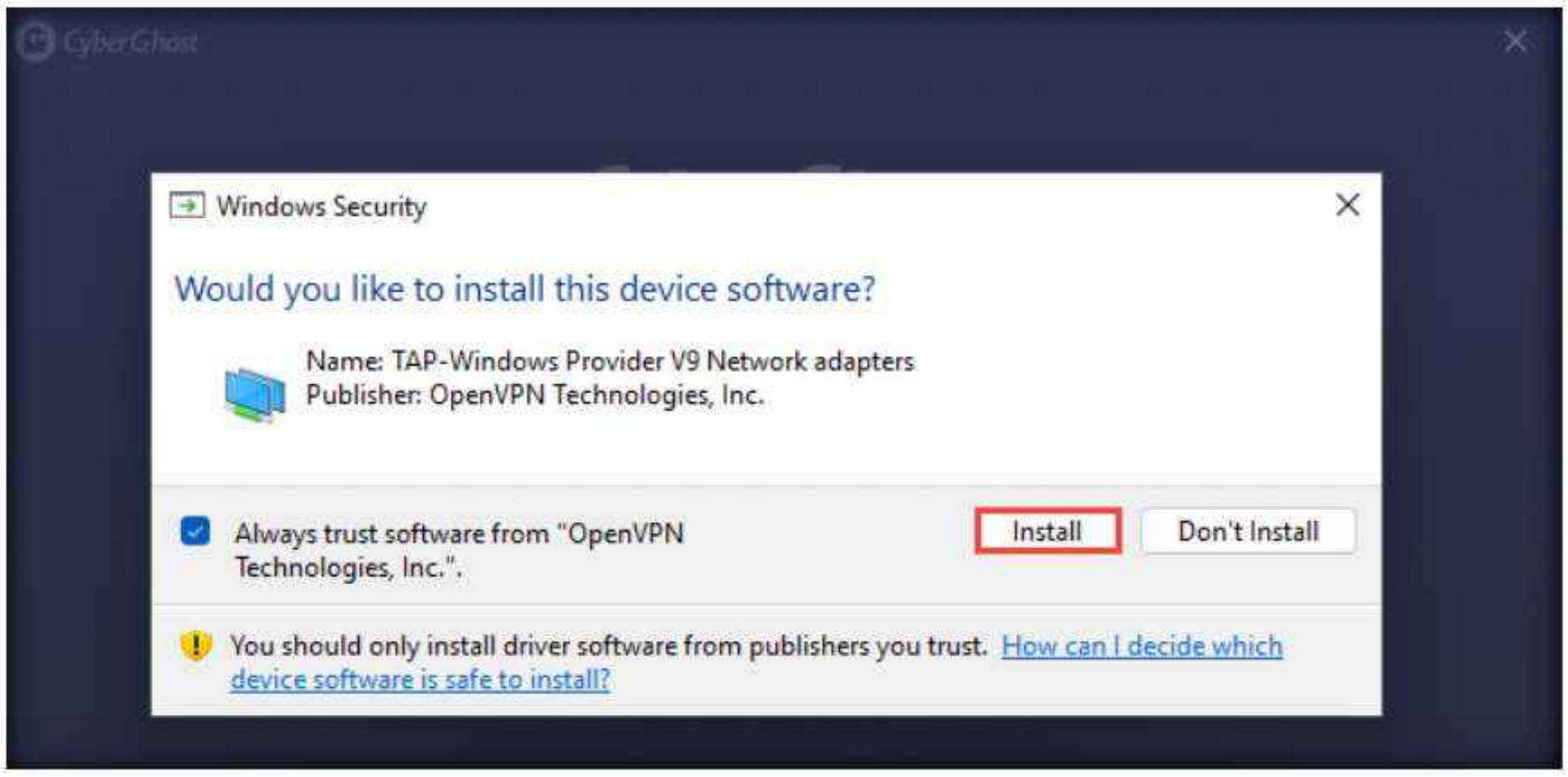
   Note: If a **User Account Control** window appears, click **Yes**.



2. **Downloading CyberGhost installer...** appears; once the CyberGhost Setup window appears, click **Accept**.



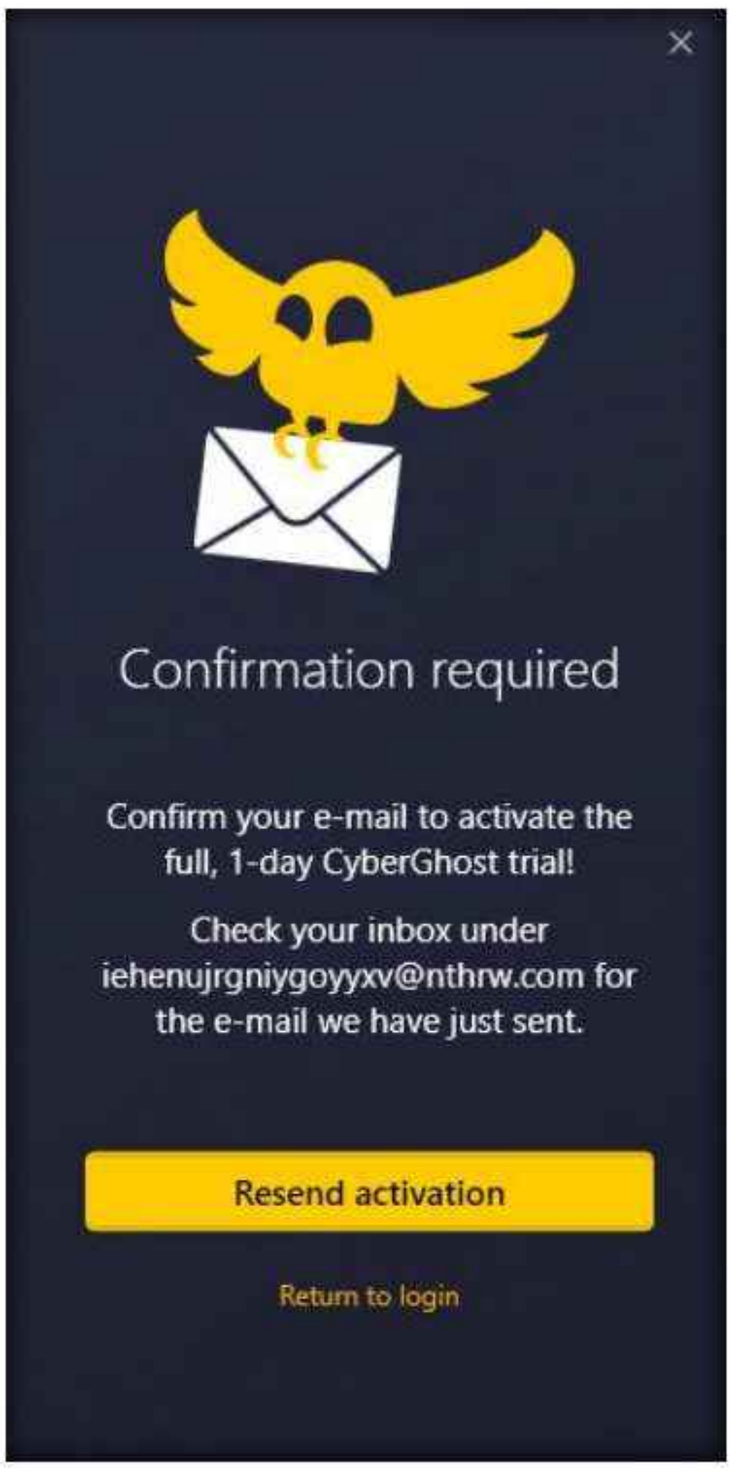
3. Follow the installation steps to install **CyberGhost**.
4. In a **Windows Security** pop-up, click **Install**.



5. In the **Your privacy is our goal** pop-up, click **Agree and continue.**
6. Once the installation is complete, the **CyberGhost8** window appears, click on **Click here to create one** link to create an account.

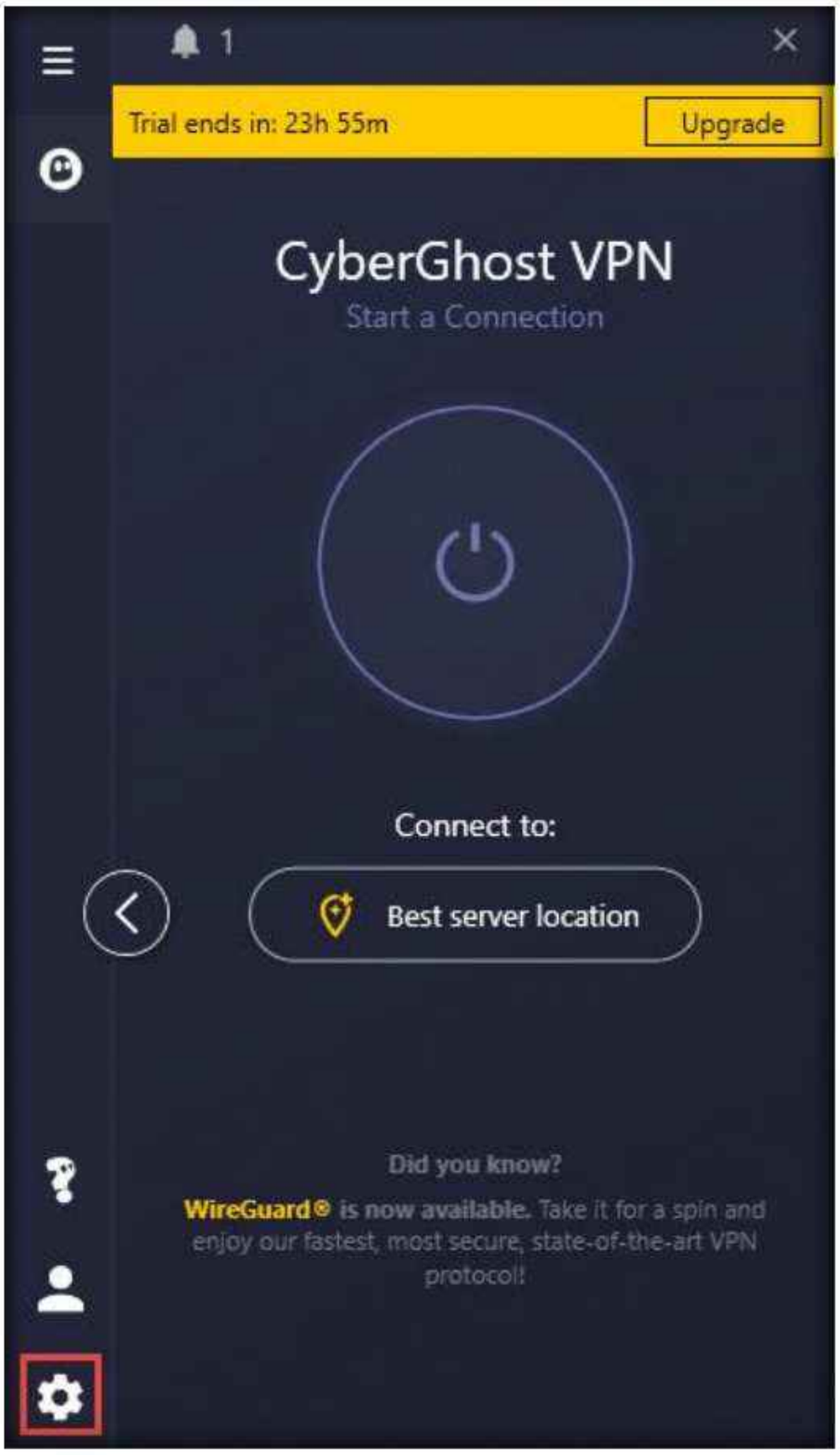
7. Create an account using your personal details and click on **Sign Up**.

8. You will receive an activation email on your personal email. Open the email and click on **Activate Trial** to start your trial version of CyberGhost.

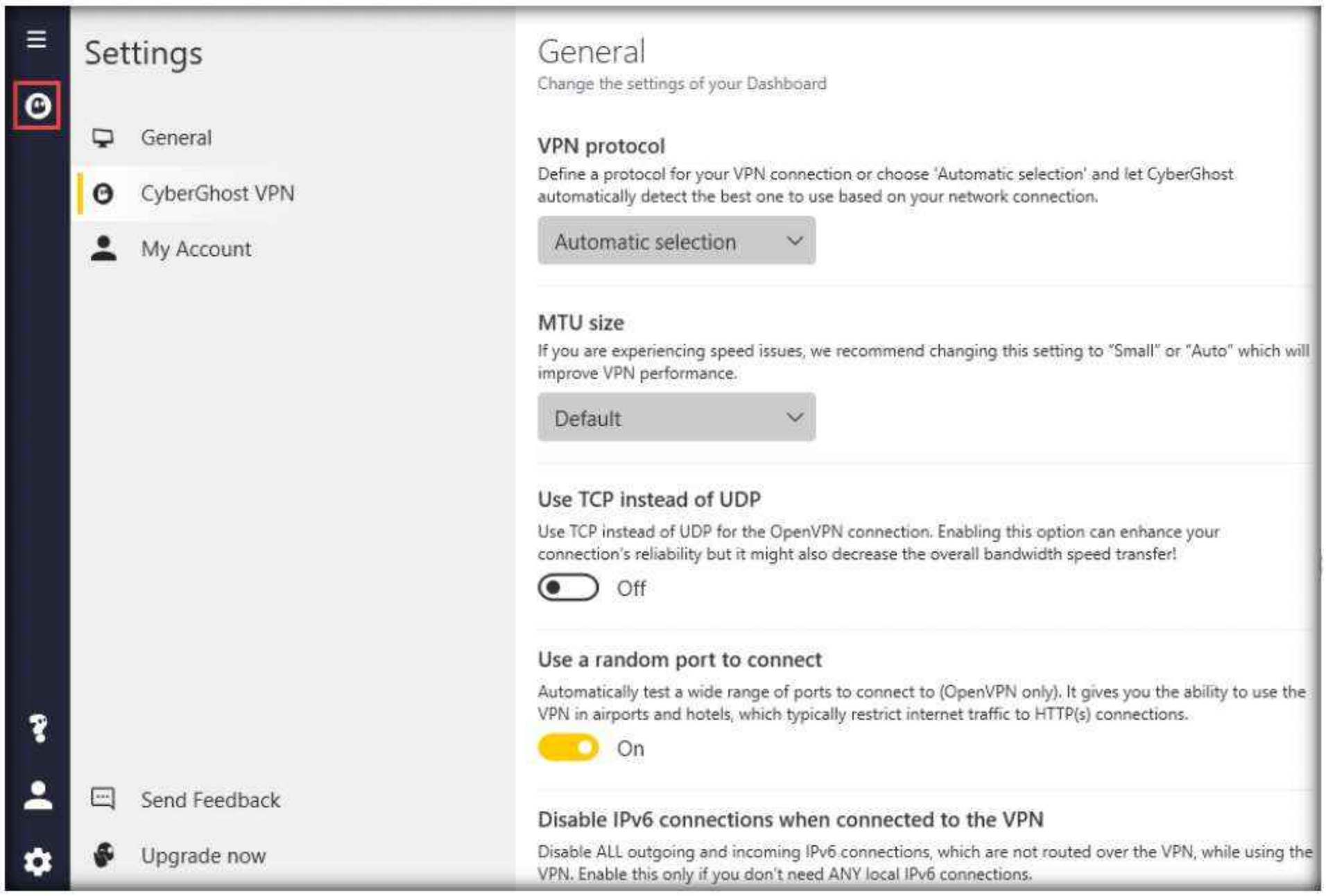


9. Now, switch to the CyberGhost page and click on **Start trial** button.

10. The **CyberGhost VPN** window appears, click the **Settings** icon.

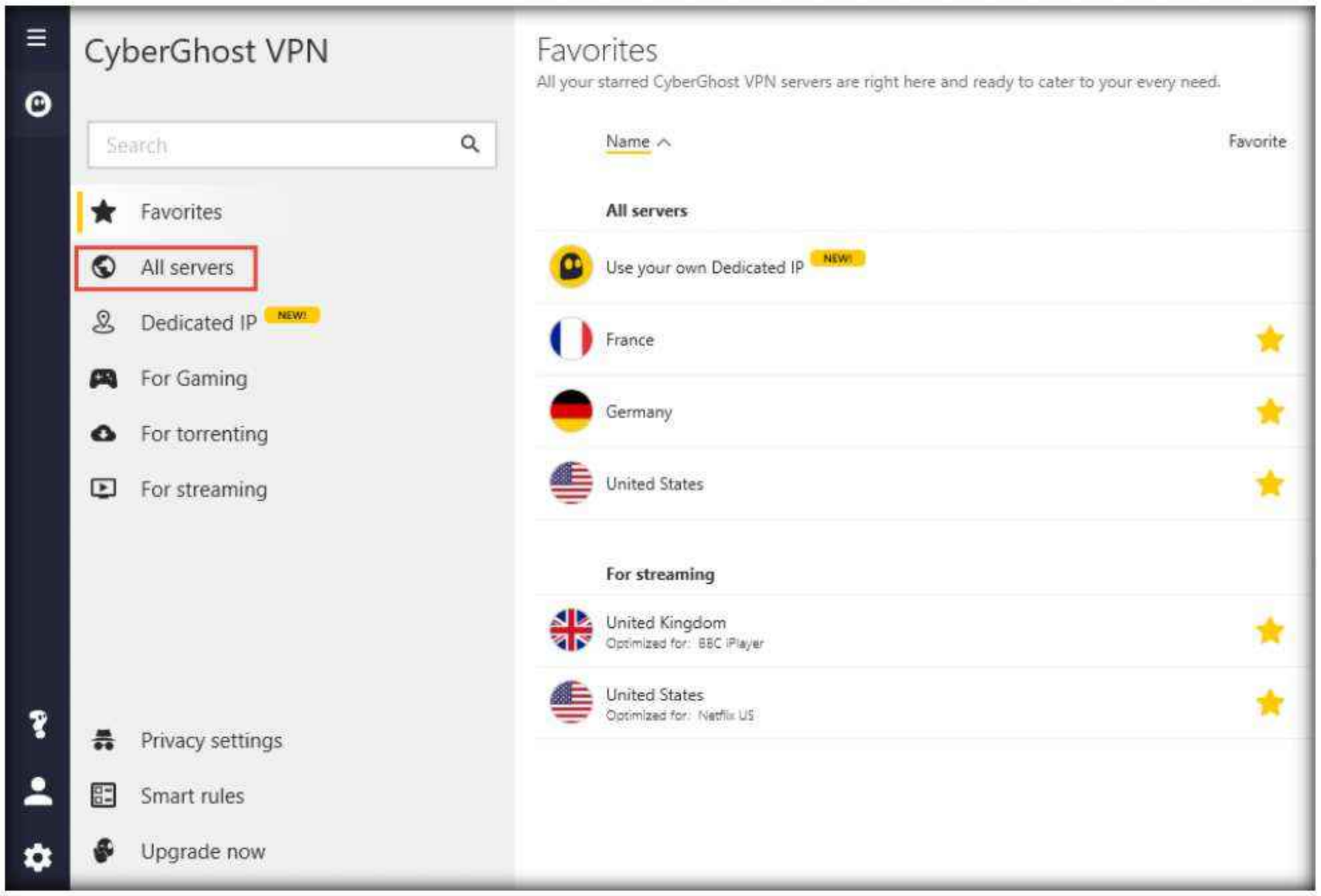


11. The **Settings** window appears, click on **CyberGhost VPN** icon ( ) under **Menu** icon

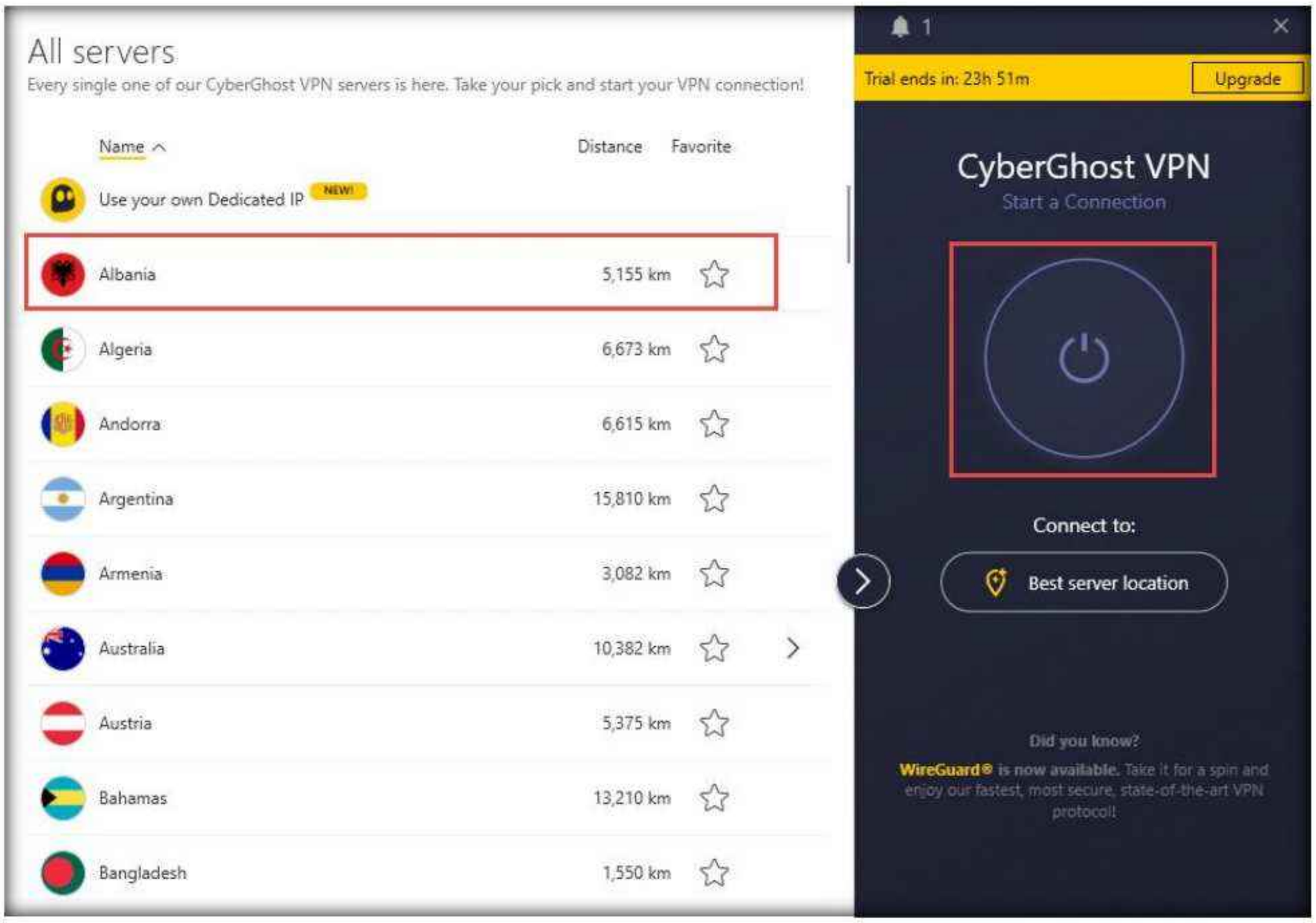


12. The **CyberGhost VPN** window appears; click on **All servers** from the left-hand pane.

    Note: The list of the servers may vary in your lab environment

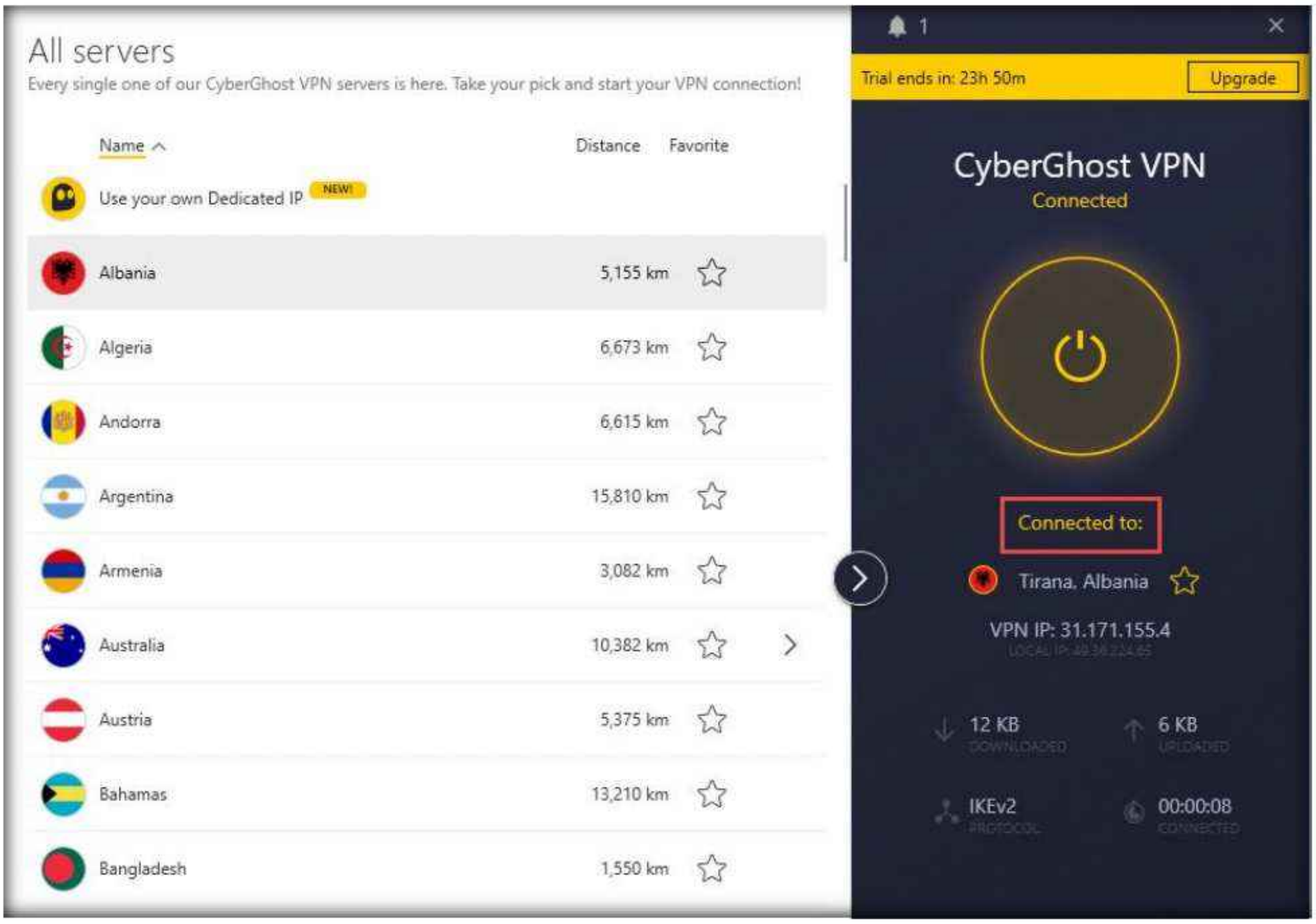


13. Click to select any proxy server from the available options in the **All servers** section (here, **Albania**) and click on the power icon ( ) under **Start a Connection** as shown in the screenshot.



Note: If the CyberGhost window appears indicating that all free user slots are booked, then close the window and select another proxy server from the "all servers" list.

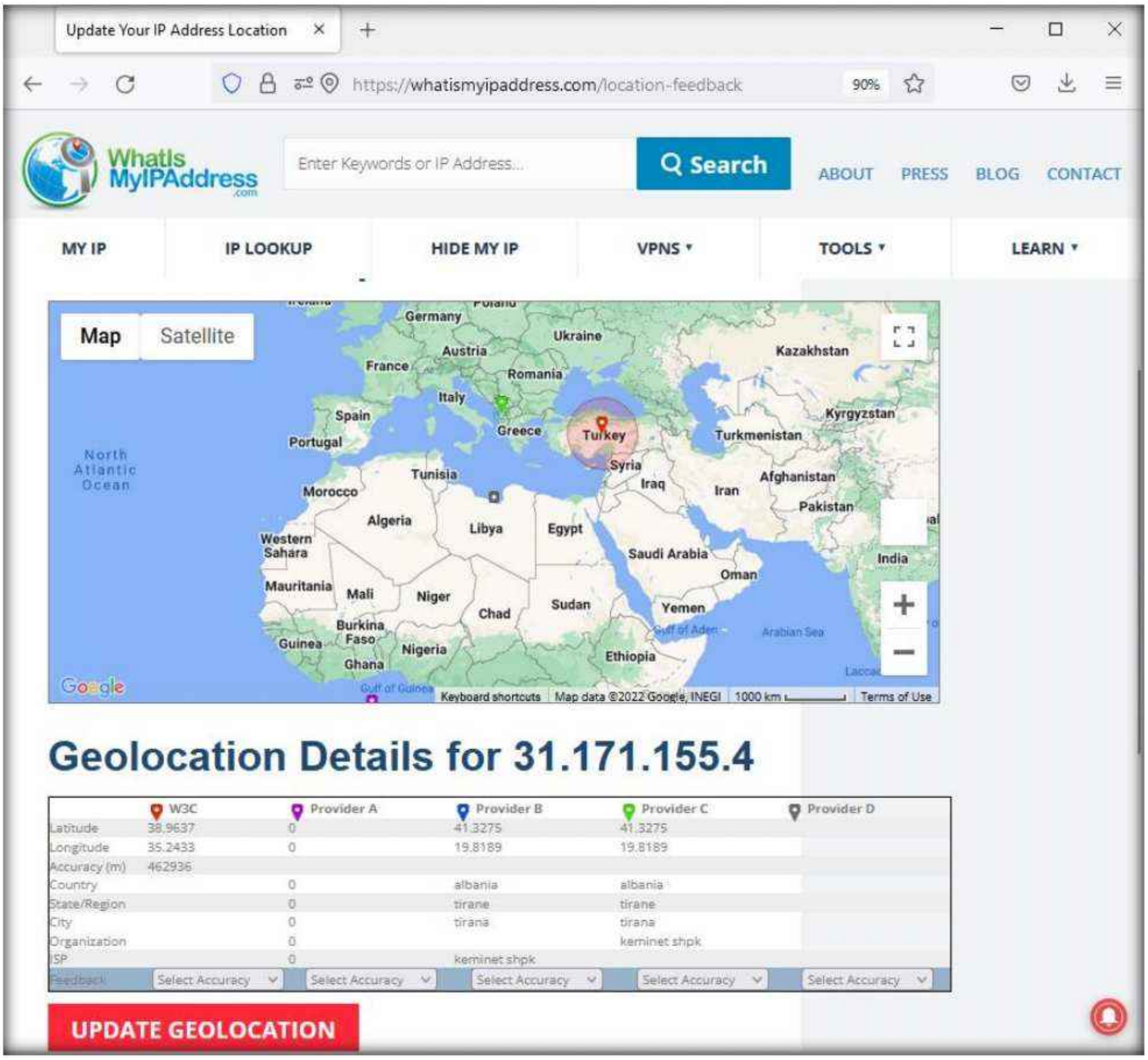
14. CyberGhost attempts to establish a connection to the proxy server. On successfully establishing a connection, **Connected** appears.



15. Minimize the **CyberGhost** window and launch the Mozilla Firefox web browser; type the URL **https://whatismyipaddress.com/location-feedback** in the address bar and press **Enter**.

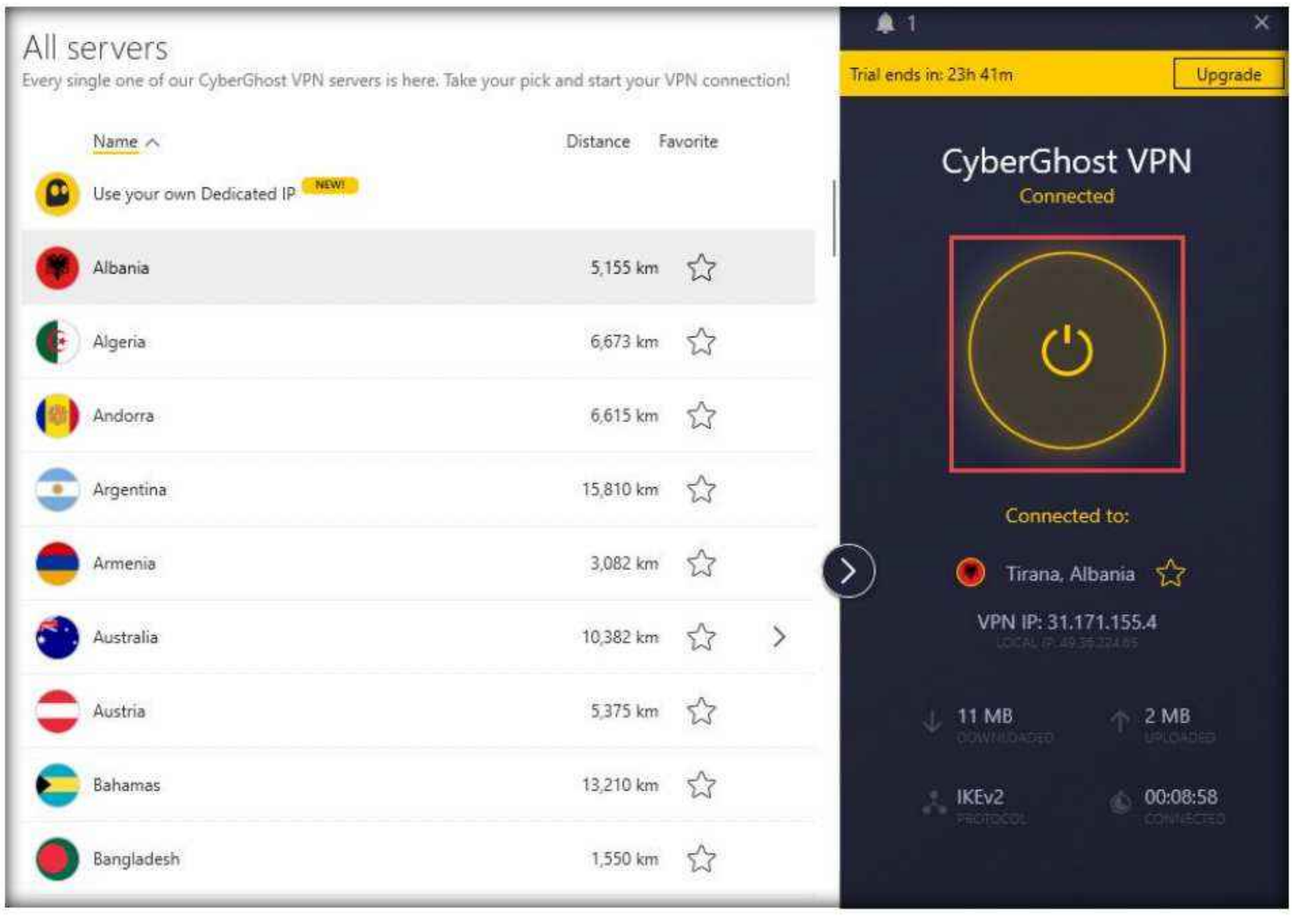
    Note: If a **Will you allow whatismyipaddress.com to access your location?** pop-up appears, click **Allow Location Access**.

16. Scroll down to the **Geographical Details** section. Observe that the server IP address and location has changed to **31.171.155.4** and **Albania**.



17. Open a new tab in the web browser and surf anonymously using this proxy.

18. Once you are done browsing, in the CyberGhost window, click the **Power** icon to disconnect the proxy, as shown in the screenshot.



19. This concludes the demonstration of anonymously surfing the Internet using CyberGhost.
20. Close all open windows and document all the acquired information.
21. Navigate to **Control Panel** → **Programs** → **Programs and Features** and uninstall the **CyberGhost 8** application.
22. Turn off the **Windows 11** virtual machine.

Lab Analysis

Analyze and document the results of this lab exercise.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Internet Connection Required	
☑ Yes	☐ No
Platform Supported	
☑ Classroom	☑ CyberQ

Lab 5

Perform Network Scanning using Various Scanning Tools

Ethical hackers and pen testers are aided in network scanning with the help of various scanning tools, which make scanning a target network an easy task.

Lab Scenario

The information obtained in the previous steps might be insufficient to reveal potential vulnerabilities in the target network: there may be more information available that could help in finding loopholes in the target network. As an ethical hacker and pen tester, you should look for as much information as possible about systems in the target network using various network scanning tools when needed. This lab will demonstrate other techniques/commands/methods that can assist you in extracting information about the systems in the target network using various scanning tools.

Lab Objectives

- Scan a target network using Metasploit

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2022 virtual machine
- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Ubuntu virtual machine
- Android virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 20 Minutes

Overview of Network Scanning Tools

Scanning tools are used to scan and identify live hosts, open ports, running services on a target network, location-info, NetBIOS info, and information about all TCP/IP and UDP open ports. Information obtained from these tools will assist an ethical hacker in creating the profile of the target organization and to scan the network for open ports of the devices connected.

Lab Tasks

Task 1: Scan a Target Network using Metasploit

Metasploit Framework is a tool that provides information about security vulnerabilities in the target organization's system, and aids in penetration testing and IDS signature development. It facilitates the tasks of attackers, exploit writers, and payload writers. A major advantage of the framework is the modular approach, that is, allowing the combination of any exploit with any payload.

Here, we will use Metasploit to discover active hosts, open ports, services running, and OS details of systems present in the target network.

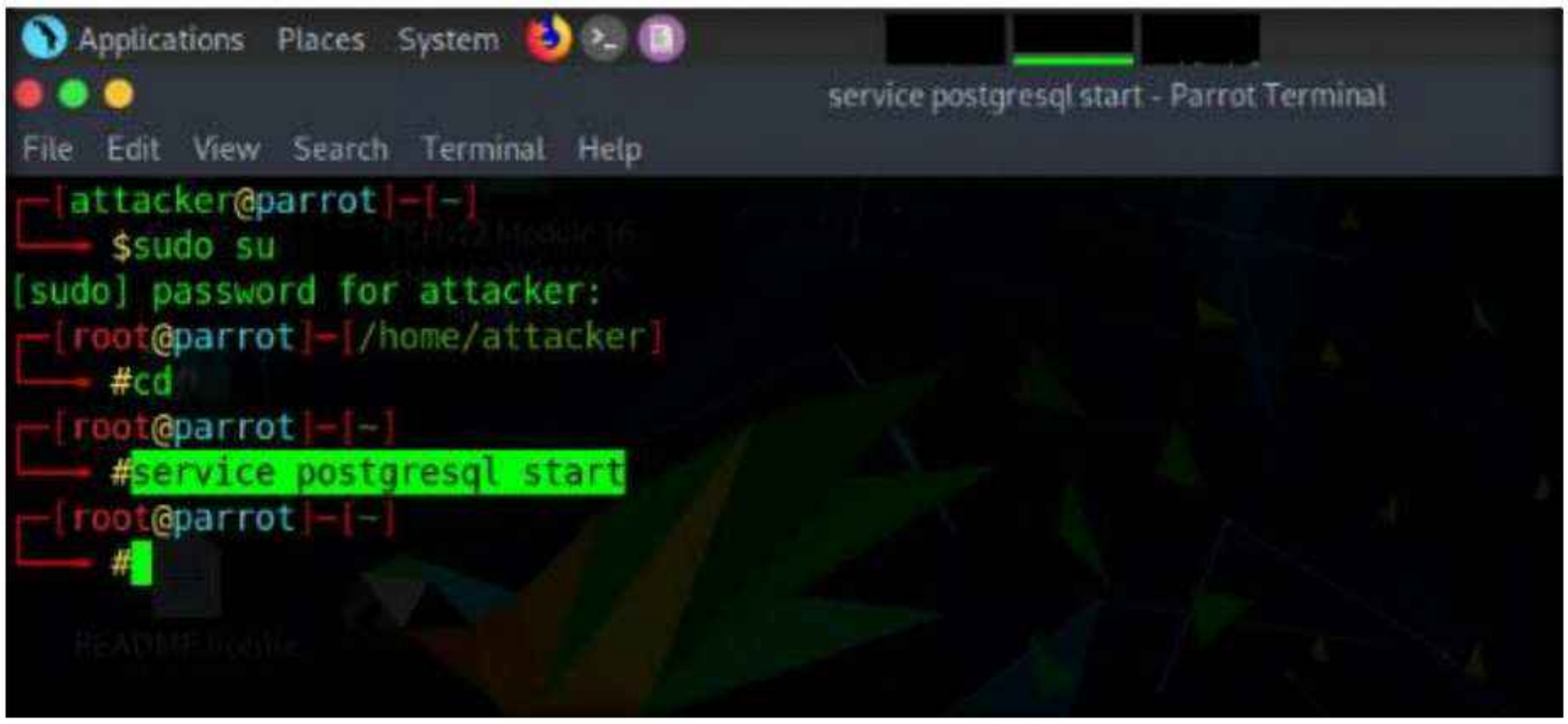
1. Before beginning this task, turn on the **Windows 11**, **Windows Server 2022**, **Windows Server 2019**, **Ubuntu**, **Parrot Security** and **Android** virtual machines.
2. Switch to the **Parrot Security** virtual machine.
3. In the login page, the **attacker** username will be selected by default. Enter password as **toor** in the **Password** field and press **Enter** to log in to the machine.

   Note: If a **Parrot Updater** pop-up appears at the top-right corner of **Desktop**, ignore and close it.

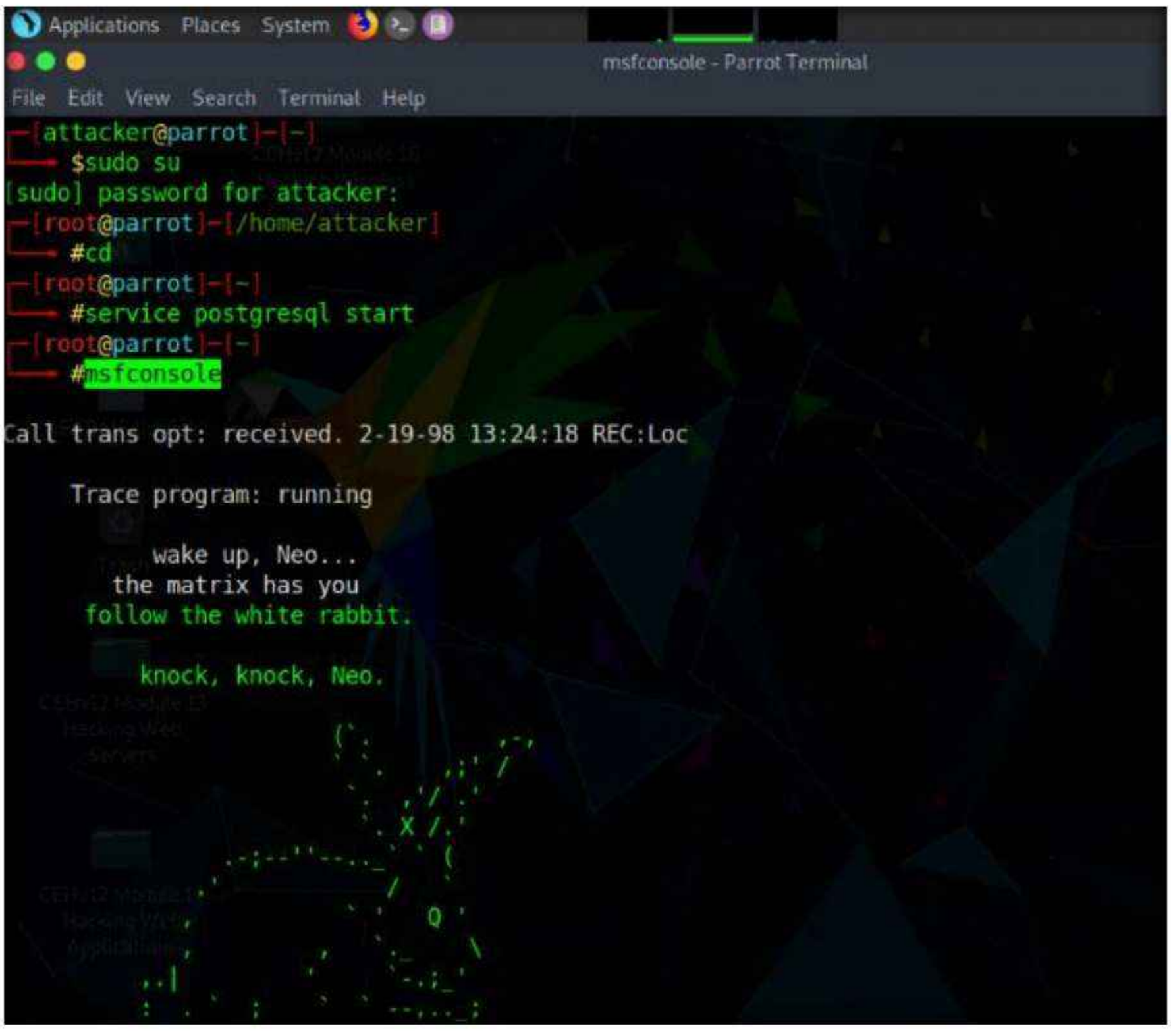
   Note: If a **Question** pop-up window appears asking you to update the machine, click **No** to close the window.
4. Click the **MATE Terminal** icon in the top of the **Desktop** to open a **Terminal** window.
5. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
6. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.
7. Now, type **cd** and press **Enter** to jump to the root directory.

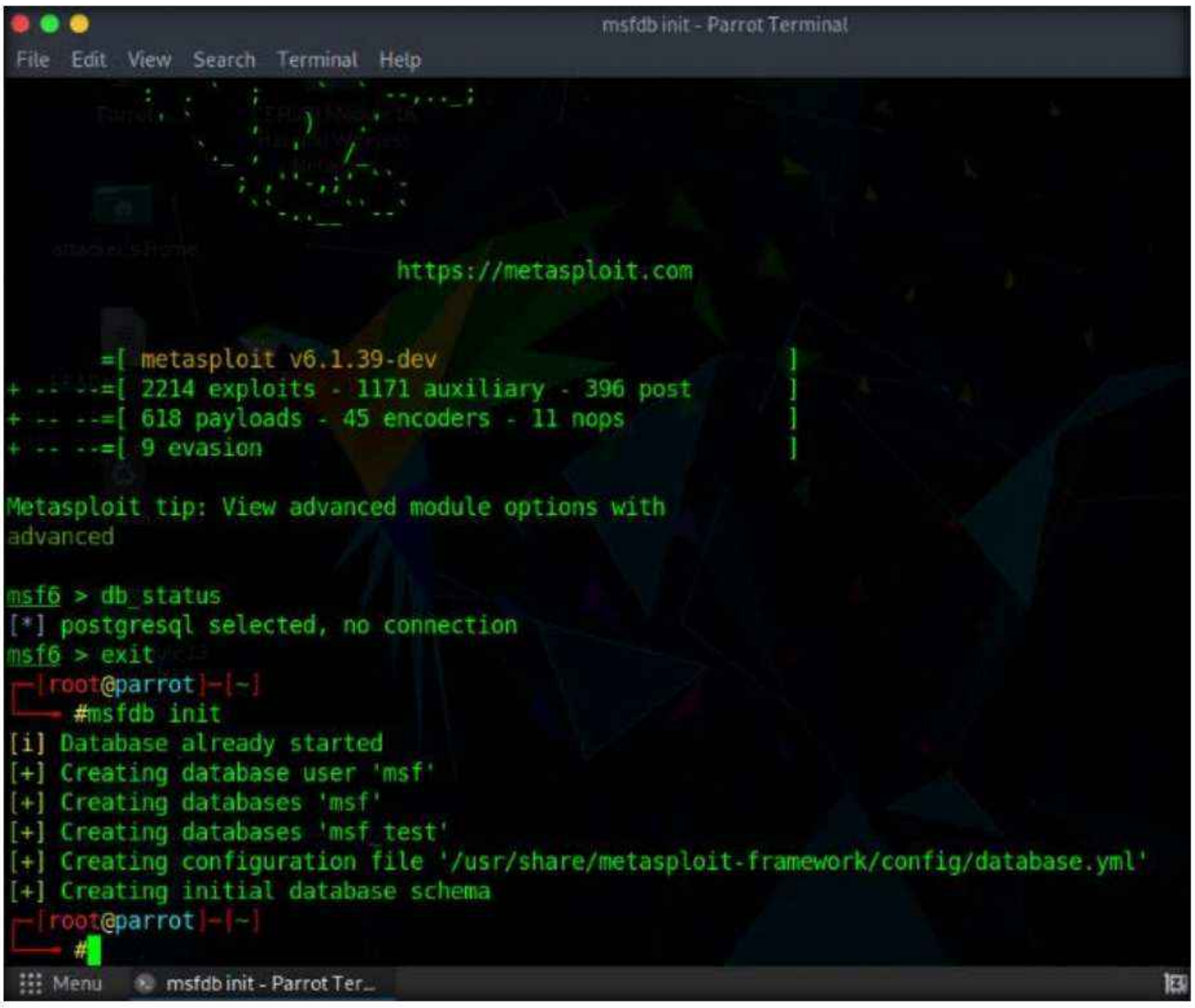
8. In the **Parrot Terminal** window, type **service postgresql start** and hit **Enter**.



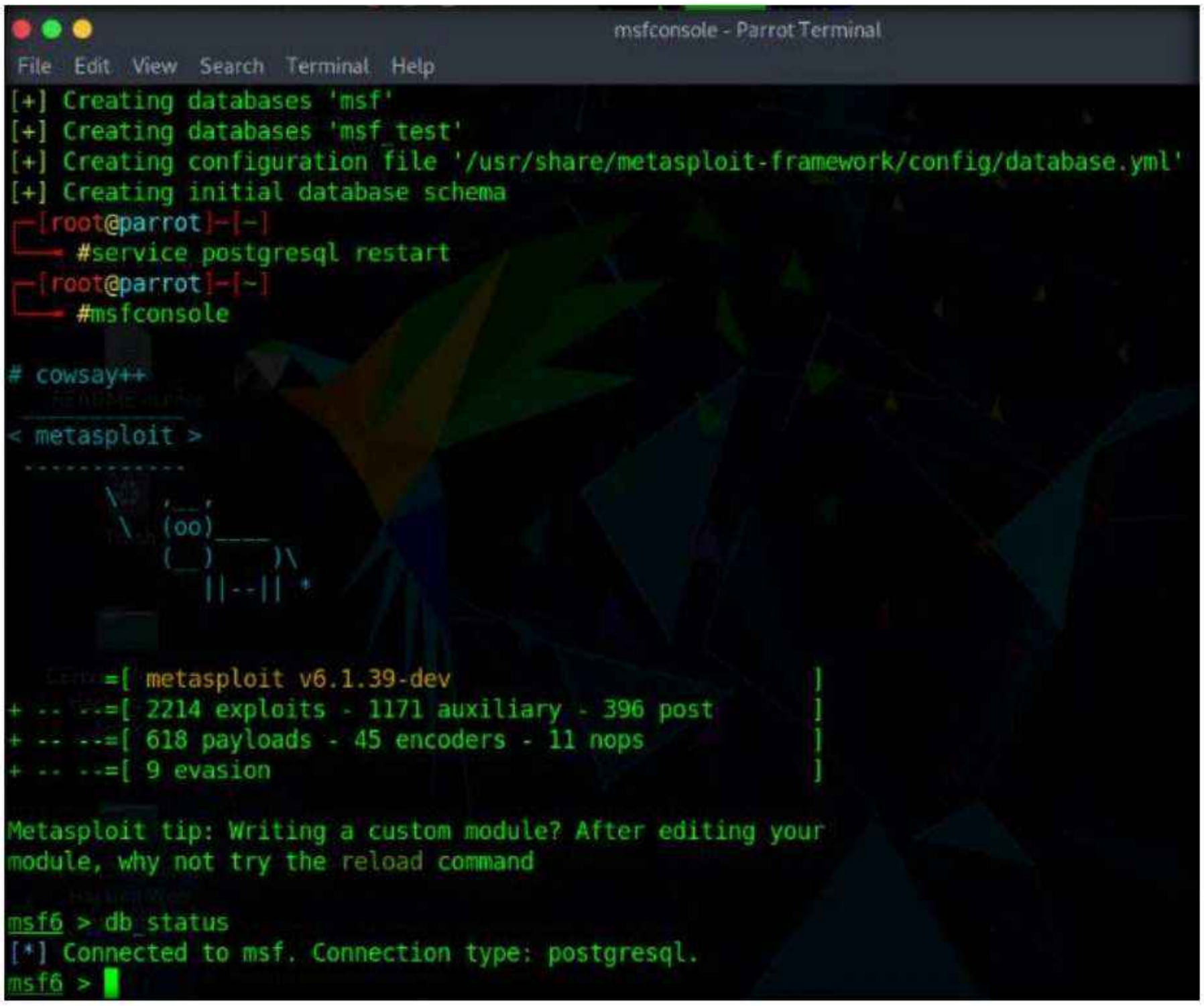
9. Now, type **msfconsole** and hit **Enter** to launch Metasploit.



10. An msf command line appears. Type **db_status** and hit **Enter** to check if Metasploit has connected to the database successfully. If you receive the message "**postgresql selected, no connection**," then the database did not connect to msf.
11. Exit the Metasploit framework by typing **exit** and press **Enter**. Then, to initiate the database, type **msfdb init**, and press **Enter**.



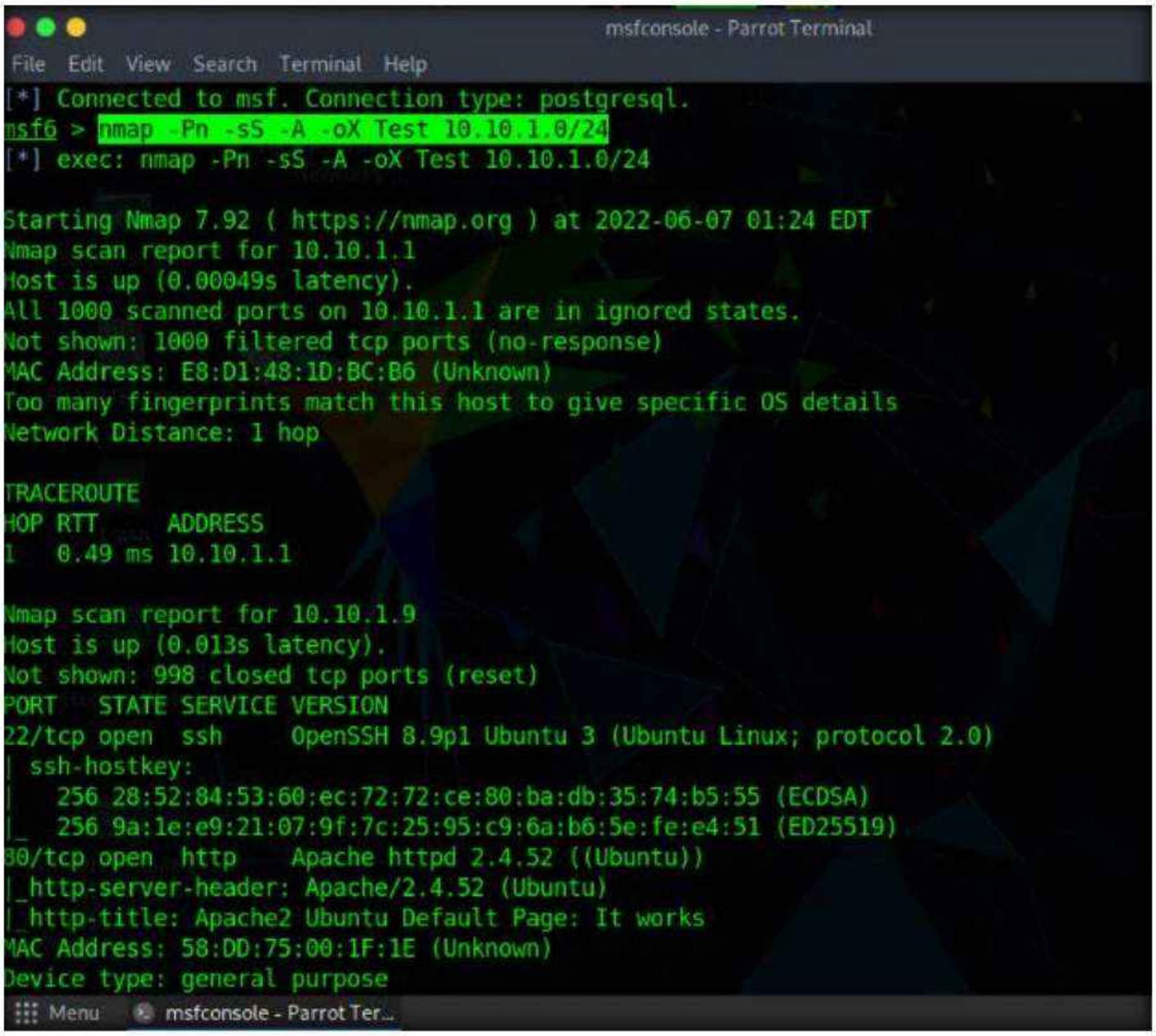
12. To restart the postgresql service, type **service postgresql restart** and press **Enter**. Now, start the Metasploit Framework again by typing **msfconsole** and pressing **Enter**.
13. Check the database status by typing **db_status** and press **Enter**. This time, the database should successfully connect to msf, as shown in the screenshot.



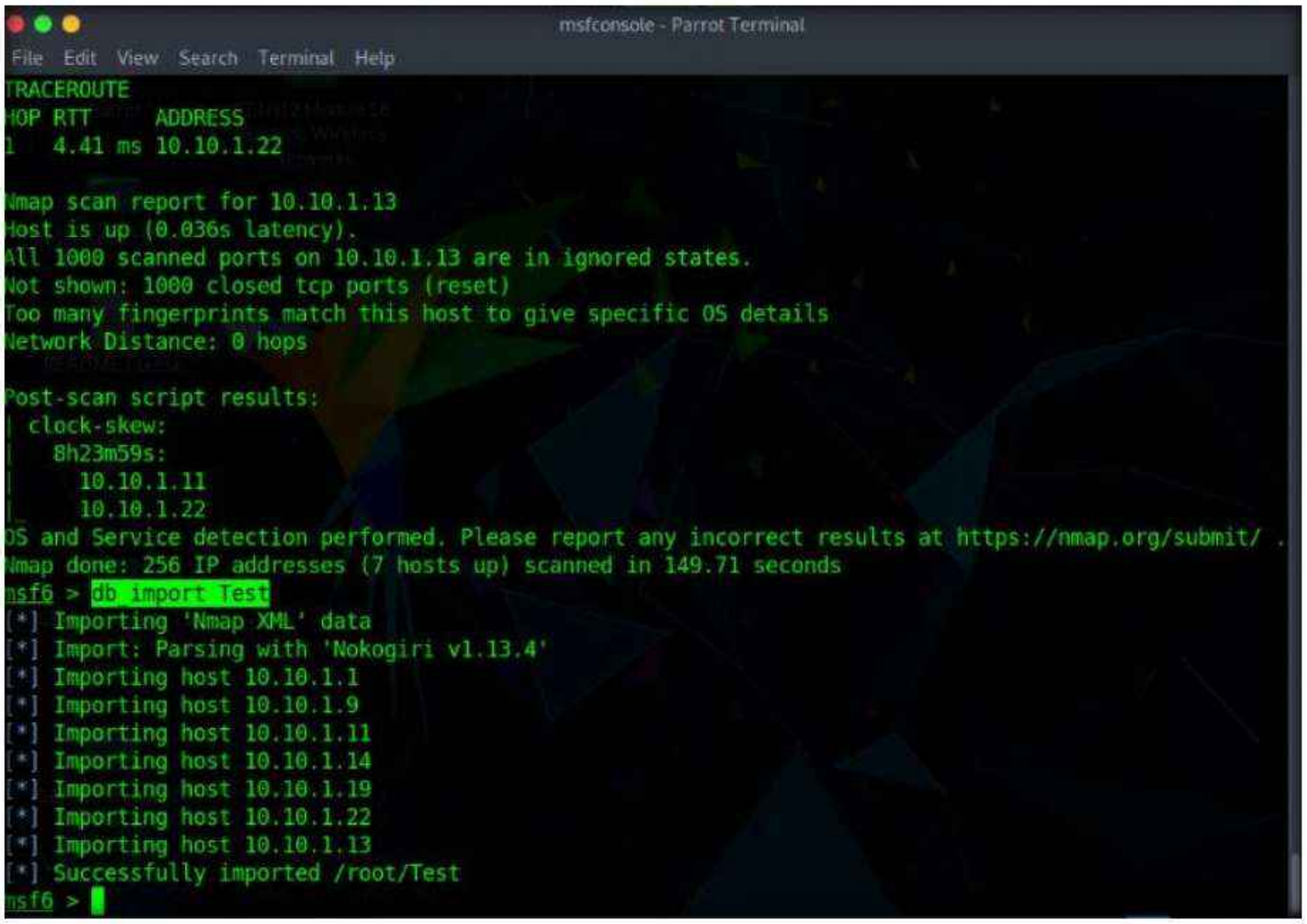
14. Type **nmap -Pn -sS -A -oX Test 10.10.1.0/24** and hit **Enter** to scan the subnet, as shown in the screenshot.

    Note: Here, we are scanning the whole subnet 10.10.1.0/24 for active hosts.

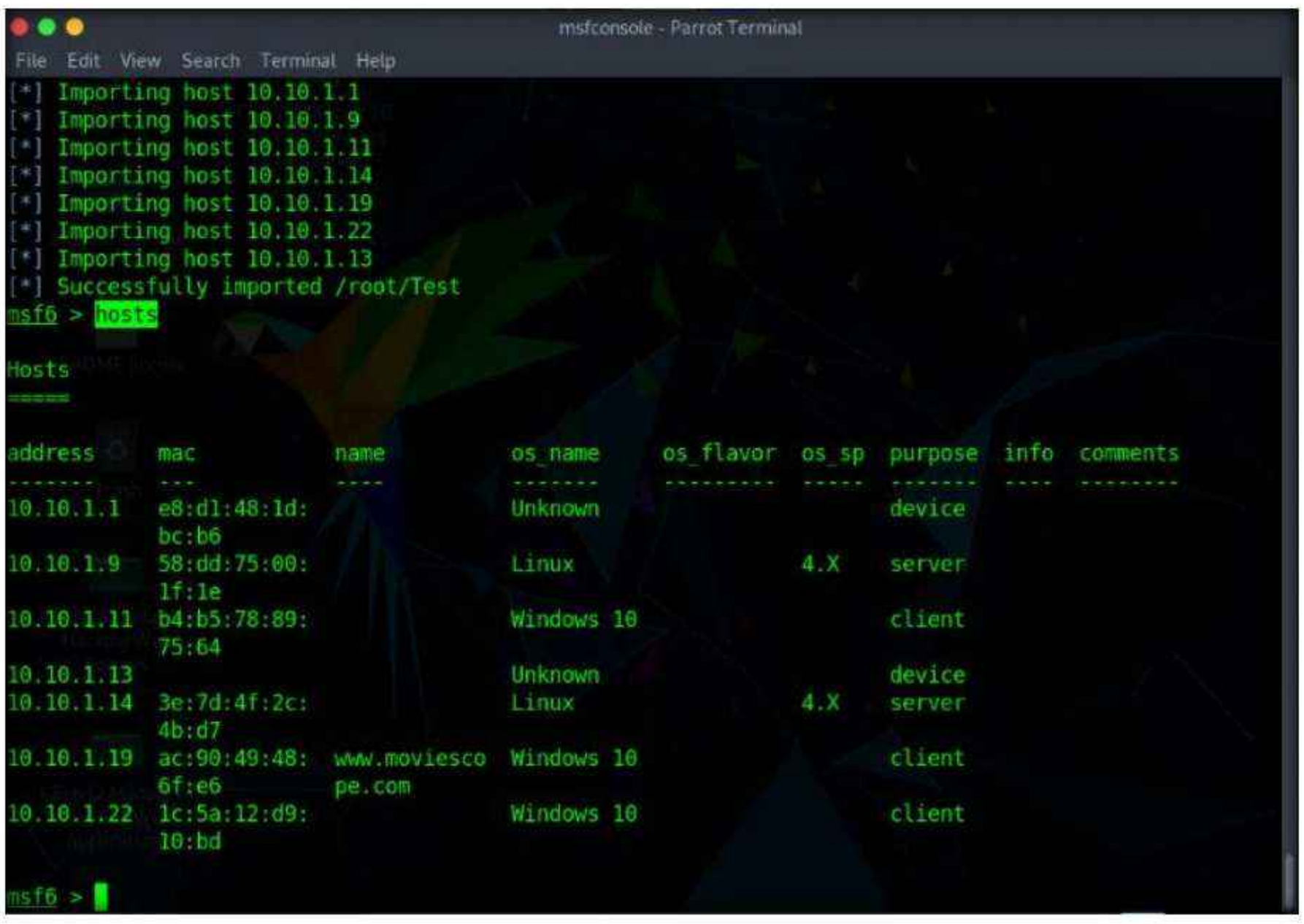
15. Nmap begins scanning the subnet and displays the results. It takes approximately 5 minutes for the scan to complete.



16. After the scan completes, Nmap displays the number of active hosts in the target network (here, **7**).
17. Now, type **db_import Test** and hit **Enter** to import the Nmap results from the database.

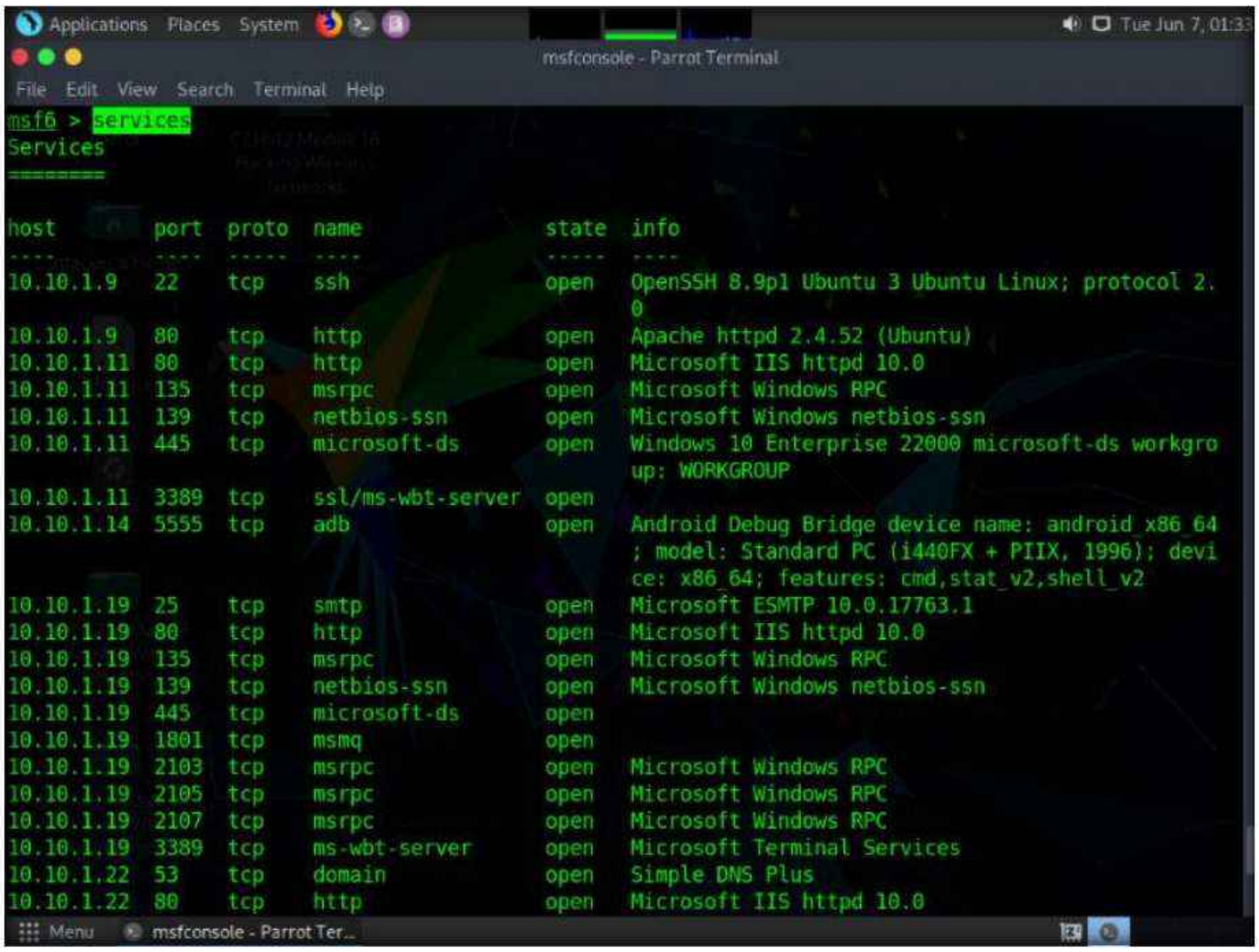


18. Type **hosts** and hit **Enter** to view the list of active hosts along with their MAC addresses, OS names, etc. as shown in the screenshot.

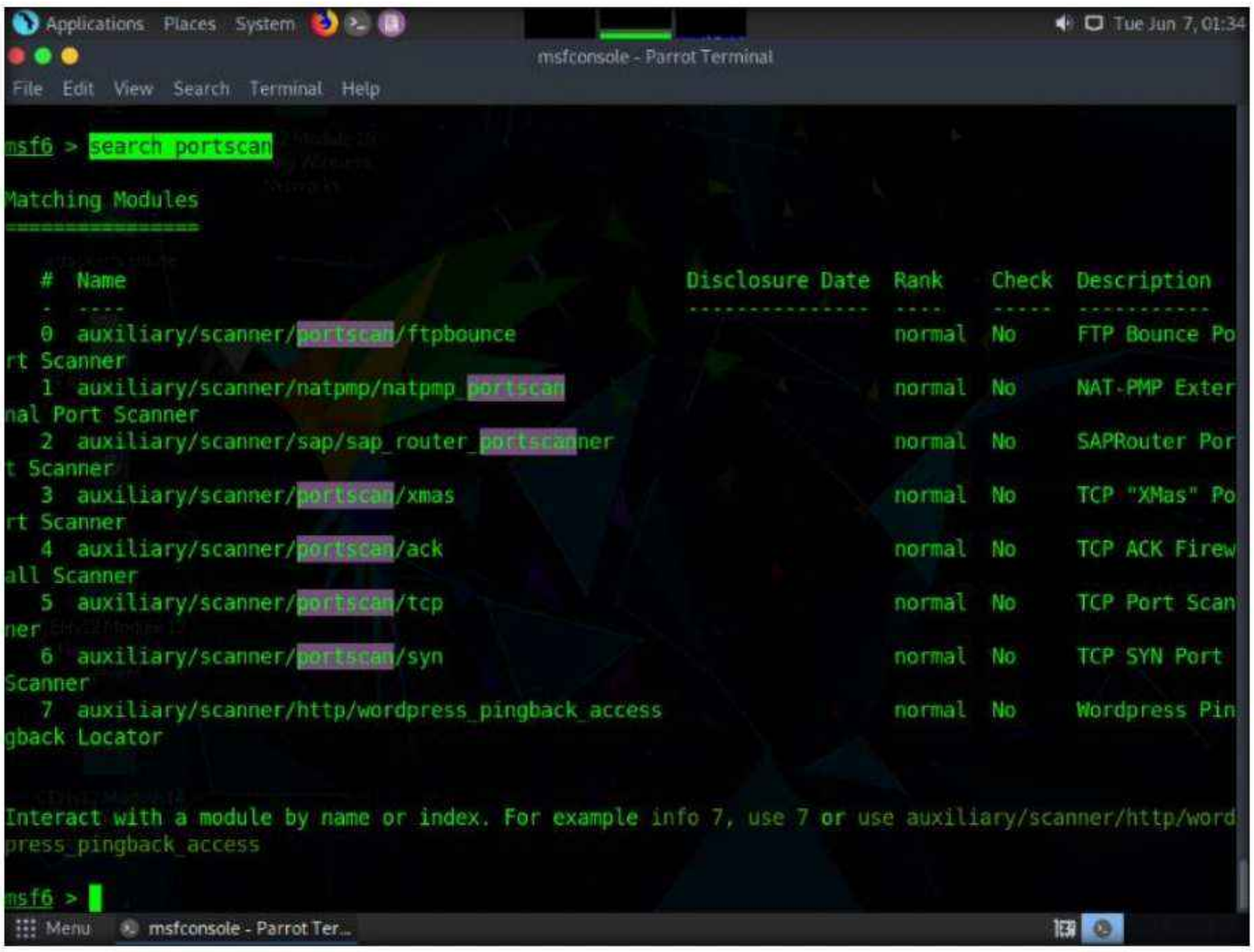


19. Type **services** or **db_services** and hit **Enter** to receive a list of the services running on the active hosts, as shown in the screenshot.

    Note: In addition to running Nmap, there are a variety of other port scanners that are available within the Metasploit framework to scan the target systems.



20. Type **search portscan** and hit **Enter**. The Metasploit port scanning modules appear, as shown in the screenshot.



21. Here, we will use the **auxiliary/scanner/portscan/syn** module to perform an SYN scan on the target systems. To do so, type **use auxiliary/scanner/portscan/syn** and press **Enter**.
22. We will use this module to perform an SYN scan against the target IP address range (**10.10.1.5-23**) to look for open port 80 through the eth0 interface.

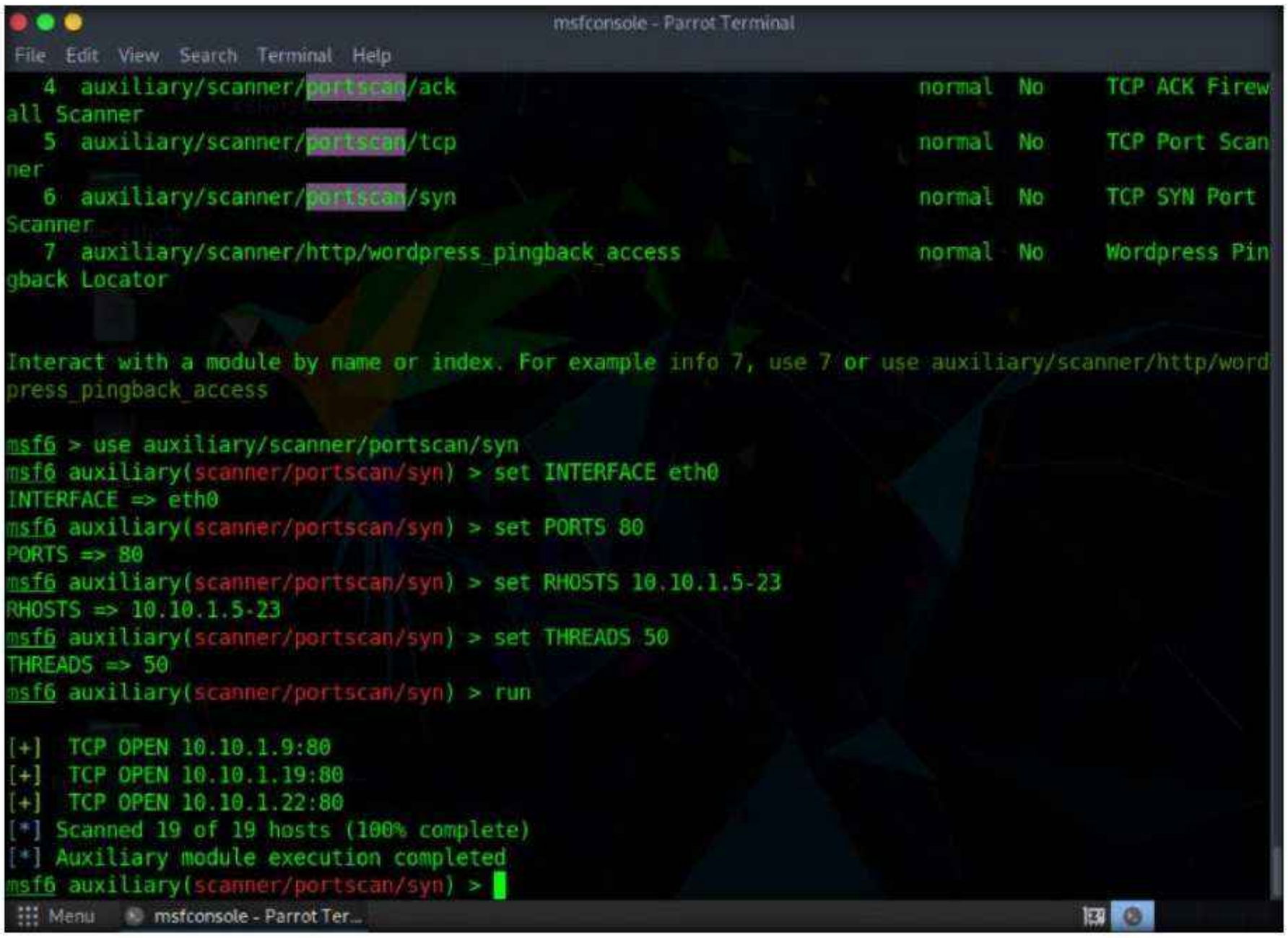
    To do so, issue the below commands:

    - **set INTERFACE eth0**
    - **set PORTS 80**
    - **set RHOSTS 10.10.1.5-23**
    - **set THREADS 50**

    Note: **PORTS**: specifies the ports to scan (e.g., 22-25, 80, 110-900), **RHOSTS**: specifies the target address range or CIDR identifier, and THREADS: specifies the number of concurrent threads (default 1).
23. After specifying the above values, type **run**, and press **Enter** to initiate the scan against the target IP address range.

Note: Similarly, you can also specify a range of ports to be scanned against the target IP address range.

24. The result appears, displaying open port 80 in active hosts, as shown in the screenshot.



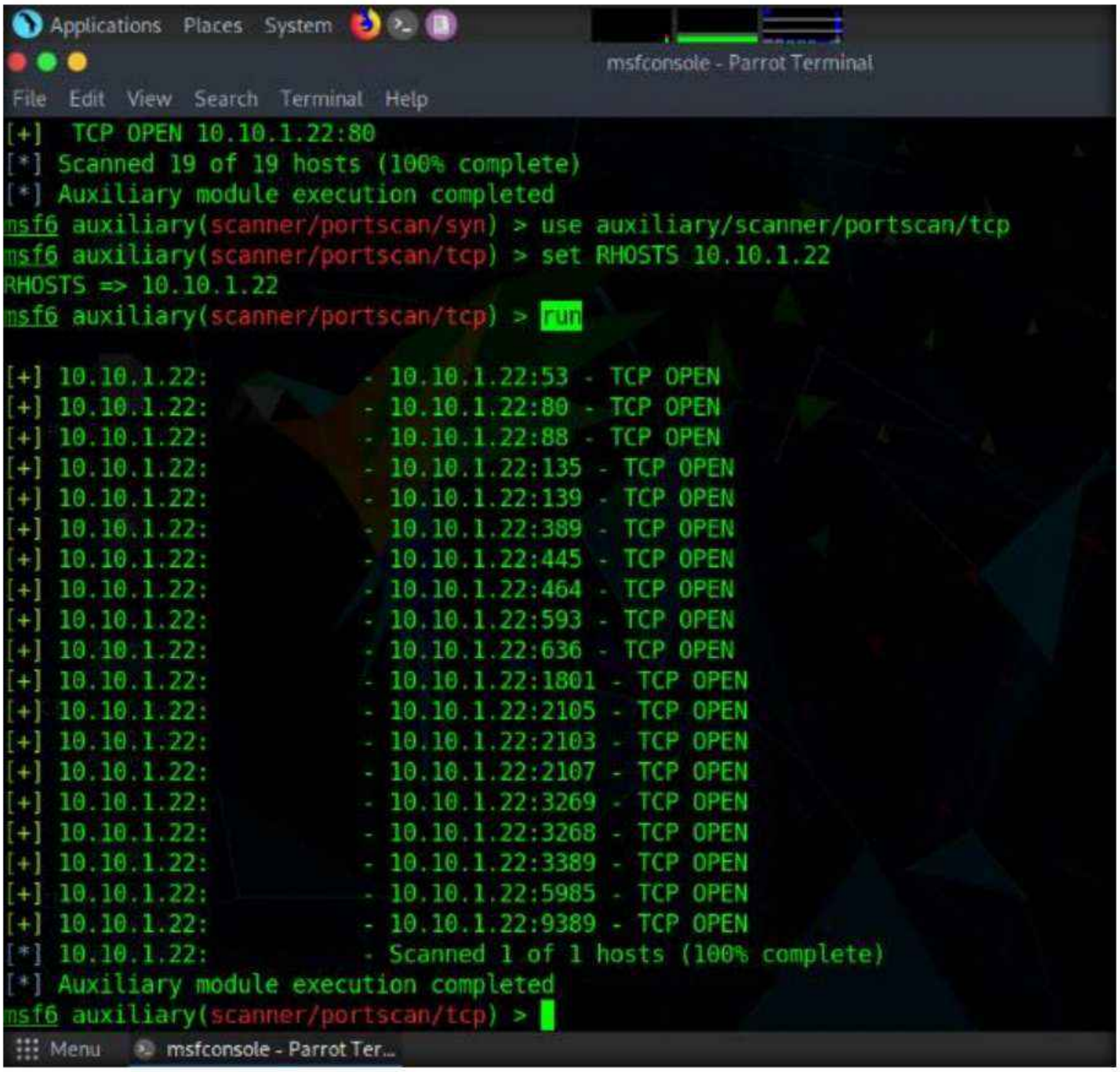
25. Now, we will perform a TCP scan for open ports on the target systems.
26. To load the **auxiliary/scanner/portscan/tcp** module, type **use auxiliary/scanner/portscan/tcp** and press **Enter**.
27. Type **hosts -R** and press **Enter** to automatically set this option with the discovered hosts present in our database.

    OR

    Type **set RHOSTS [Target IP Address]** and press **Enter**.

    Note: Here, we will perform a TCP scan for open ports on a single IP address (**10.10.1.22**), as scanning multiple IP addresses consumes much time.
28. Type **run** and press **Enter** to discover open TCP ports in the target system.

    Note: It will take approximately 20 minutes for the scan to complete.
29. The results appear, displaying all open TCP ports in the target IP address (10.10.1.22).



30. Now that we have determined the active hosts on the target network, we can further attempt to determine the OSes running on the target systems. As there are systems in our scan that have port 445 open, we will use the module scanner/smb/version to determine which version of Windows is running on a target and which Samba version is on a Linux host.
31. To do so, first type **back**, and then press **Enter** to revert to the msf command line. Then, type **use auxiliary/scanner/smb/smb_version** and press **Enter**.
32. We will use this module to run a SMB version scan against the target IP address range (**10.10.1.5-23**). To do so, issue the below commands:
    - **set RHOSTS 10.10.1.5-23**
    - **set THREADS 11**

```
[+] 10.10.1.22:            - 10.10.1.22:3269 - TCP OPEN
[+] 10.10.1.22:            - 10.10.1.22:3268 - TCP OPEN
[+] 10.10.1.22:            - 10.10.1.22:3389 - TCP OPEN
[+] 10.10.1.22:            - 10.10.1.22:5985 - TCP OPEN
[+] 10.10.1.22:            - 10.10.1.22:9389 - TCP OPEN
[*] 10.10.1.22:            - Scanned 1 of 1 hosts (100% complete)
[*] Auxiliary module execution completed
msf6 auxiliary(scanner/portscan/tcp) > back
msf6 > use auxiliary/scanner/smb/smb_version
msf6 auxiliary(scanner/smb/smb_version) > set RHOSTS 10.10.1.5-23
RHOSTS => 10.10.1.5-23
msf6 auxiliary(scanner/smb/smb_version) > set THREADS 11
THREADS => 11
msf6 auxiliary(scanner/smb/smb_version) >
Menu   msfconsole - Parrot Ter...
```

33. Type **run** and press **Enter** to discover SMB version in the target systems.

34. The result appears, displaying the OS details of the target hosts.

```
Applications  Places  System                                   Tue Jun 7, 02:07
msfconsole - Parrot Terminal
File  Edit  View  Search  Terminal  Help
RHOSTS => 10.10.1.5-23
msf6 auxiliary(scanner/smb/smb_version) > set THREADS 11
THREADS => 11
msf6 auxiliary(scanner/smb/smb_version) > run

[*] 10.10.1.11:445         - SMB Detected (versions:1, 2, 3) (preferred dialect:SMB 3.1.1) (compressio
n capabilities:LZNT1, Pattern_V1) (encryption capabilities:AES-256-GCM) (signatures:optional) (guid:{
71b8c44c-47ac-47c9-ae16-15fa07dcce34}) (authentication domain:WINDOWS11)
[+] 10.10.1.11:445         -   Host is running Windows 10 Enterprise (build:22000) (name:WINDOWS11) (w
orkgroup:WORKGROUP)
[*] 10.10.1.5-23:          - Scanned  4 of 19 hosts (21% complete)
[*] 10.10.1.19:445         - SMB Detected (versions:2, 3) (preferred dialect:SMB 3.1.1) (compression c
apabilities:) (encryption capabilities:AES-128-GCM) (signatures:optional) (guid:{c17060d9-c97c-4445-b
044-cb47c188eae8}) (authentication domain:SERVER2019)
[*] 10.10.1.5-23:          - Scanned  5 of 19 hosts (26% complete)
[*] 10.10.1.5-23:          - Scanned  6 of 19 hosts (31% complete)
[*] 10.10.1.5-23:          - Scanned  8 of 19 hosts (42% complete)
[*] 10.10.1.5-23:          - Scanned 10 of 19 hosts (52% complete)
[*] 10.10.1.5-23:          - Scanned 12 of 19 hosts (63% complete)
[*] 10.10.1.22:445         - SMB Detected (versions:1, 2, 3) (preferred dialect:SMB 3.1.1) (compressio
n capabilities:LZNT1, Pattern_V1) (encryption capabilities:AES-256-GCM) (signatures:required) (guid:{
d50f99a3-3846-4dc4-8459-5c59636fb8bb}) (authentication domain:CEH)
[*] 10.10.1.22:445         -   Host could not be identified: Windows Server 2022 Standard 20348 (Windo
ws Server 2022 Standard 6.3)
[*] 10.10.1.5-23:          - Scanned 14 of 19 hosts (73% complete)
[*] 10.10.1.5-23:          - Scanned 16 of 19 hosts (84% complete)
[*] 10.10.1.5-23:          - Scanned 18 of 19 hosts (94% complete)
[*] 10.10.1.5-23:          - Scanned 19 of 19 hosts (100% complete)
[*] Auxiliary module execution completed
msf6 auxiliary(scanner/smb/smb_version) >
Menu   msfconsole - Parrot Ter...
```

35. You can further explore various modules of Metasploit such as FTP module to identify the FTP version running in the target host.

36. This information can further be used to perform vulnerability analysis on the open services discovered in the target hosts.

37. This concludes the demonstration of gathering information on open ports, a list of services running on active hosts, and information related to OSes, amongst others.

38. Close all open windows and document all the acquired information.
39. Turn off the **Windows 11**, **Windows Server 2022**, **Windows Server 2019**, **Ubuntu**, **Parrot Security** and **Android** virtual machines.

Lab Analysis

Analyze and document the results of this lab exercise.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Internet Connection Required	
☐ Yes	☑ No
Platform Supported	
☑ Classroom	☑ CyberQ

CEH Lab Manual

Enumeration

Module 04

Enumeration

Enumeration is the process of extracting usernames, machine names, network resources, shares, and services from a system or network.

Lab Scenario

With the development of network technologies and applications, network attacks are greatly increasing in both number and severity. Attackers continuously search for service and application vulnerabilities on networks and servers. When they find a flaw or loophole in a service run over the Internet, they immediately exploit it to compromise the entire system. Any other data that they find may be further used to compromise additional network systems. Similarly, attackers seek out and use workstations with administrative privileges, and which run flawed applications, to execute arbitrary code or implant viruses in order to intensify damage to the network.

In the first step of the security assessment and penetration testing of your organization, you gather open-source information about your organization. In the second step, you collect information about open ports and services, OSes, and any configuration lapses.

The next step for an ethical hacker or penetration tester is to probe the target network further by performing enumeration. Using various techniques, you should extract more details about the network such as lists of computers, usernames, user groups, ports, OSes, machine names, network resources, and services.

The information gleaned from enumeration will help you to identify the vulnerabilities in your system's security that attackers would seek to exploit. Such information could also enable attackers to perform password attacks to gain unauthorized access to information system resources.

In the previous steps, you gathered necessary information about a target without contravening any legal boundaries. However, please note that enumeration activities may be illegal depending on an organization's policies and any laws that are in effect in your location. As an ethical hacker or penetration tester, you should always acquire proper authorization before performing enumeration.

Lab Objective

The objective of the lab is to extract information about the target organization that includes, but is not limited to:

- Machine names, their OSes, services, and ports
- Network resources
- Usernames and user groups
- Lists of shares on individual hosts on the network
- Policies and passwords

- Routing tables
- Audit and service settings
- SNMP and FQDN details

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2022 virtual machine
- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Ubuntu virtual machine
- Android virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 145 Minutes

Overview of Enumeration

Enumeration creates an active connection with the system and performs directed queries to gain more information about the target. It extracts lists of computers, usernames, user groups, ports, OSes, machine names, network resources, and services using various techniques. Enumeration techniques are conducted in an intranet environment.

Lab Tasks

Ethical hackers or penetration testers use several tools and techniques to enumerate the target network. Recommended labs that will assist you in learning various enumeration techniques include:

Lab No.	Lab Exercise Name	Core*	Self-study**	CyberQ ***
1	Perform NetBIOS Enumeration	√	√	√
	1.1 Perform NetBIOS Enumeration using Windows Command-Line Utilities	√		√
	1.2 Perform NetBIOS Enumeration using NetBIOS Enumerator		√	√
	1.3 Perform NetBIOS Enumeration using an NSE Script		√	√

2	Perform SNMP Enumeration	√	√	√
	2.1 Perform SNMP Enumeration using snmp-check		√	√
	2.2 Perform SNMP Enumeration using SoftPerfect Network Scanner		√	√
	2.3 Perform SNMP Enumeration using SnmpWalk	√		√
	2.4 Perform SNMP Enumeration using Nmap		√	√
3	Perform LDAP Enumeration	√	√	√
	3.1 Perform LDAP Enumeration using Active Directory Explorer (AD Explorer)	√		√
	3.2 Perform LDAP Enumeration using Python and Nmap		√	√
	3.3 Perform LDAP Enumeration using ldapsearch		√	√
4	Perform NFS Enumeration	√		√
	4.1 Perform NFS Enumeration using RPCScan and SuperEnum	√		√
5	Perform DNS Enumeration	√	√	√
	5.1 Perform DNS Enumeration using Zone Transfer	√		√
	5.2 Perform DNS Enumeration using DNSSEC Zone Walking		√	√
	5.3 Perform DNS Enumeration using Nmap		√	√
6	Perform SMTP Enumeration	√		√
	6.1 Perform SMTP Enumeration using Nmap	√		√
7	Perform RPC, SMB, and FTP Enumeration		√	√
	7.1 Perform SMB and RPC Enumeration using NetScanTools Pro		√	√
	7.2 Perform RPC, SMB, and FTP Enumeration using Nmap		√	√
8	Perform Enumeration using Various Enumeration Tools	√	√	√
	8.1 Enumerate Information using Global Network Inventory	√		√
	8.2 Enumerate Network Resources using Advanced IP Scanner		√	√
	8.3 Enumerate Information from Windows and Samba Hosts using Enum4linux		√	√

Remark

EC-Council has prepared a considered amount of lab exercises for student to practice during the 5-day class and at their free time to enhance their knowledge and skill.

***Core** - Lab exercise(s) marked under Core are recommended by EC-Council to be practised during the 5-day class.

****Self-study** - Lab exercise(s) marked under self-study is for students to practise at their free time. Steps to access the additional lab exercises can be found in the first page of CEHv12 volume 1 book.

*****CyberQ** - Lab exercise(s) marked under CyberQ are available in our CyberQ solution. CyberQ is a cloud-based virtual lab environment preconfigured with vulnerabilities, exploits, tools and scripts, and can be accessed from anywhere with an Internet connection. If you are interested to learn more about our CyberQ solution, please contact your training center or visit https://www.cyberq.io/.

Lab Analysis

Analyze and document the results related to this lab exercise. Give an opinion on your target's security posture.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Perform NetBIOS Enumeration

NetBIOS enumeration is a process of obtaining sensitive information about the target such as a list of computers belonging to a target domain, network shares, policies, etc.

Lab Scenario

As a professional ethical hacker or penetration tester, your first step in the enumeration of a Windows system is to exploit the NetBIOS API. NetBIOS enumeration allows you to collect information about the target such as a list of computers that belong to a target domain, shares on individual hosts in the target network, policies, passwords, etc. This data can be used to probe the machines further for detailed information about the network and host resources.

Lab Objectives

- Perform NetBIOS enumeration using Windows command-line utilities
- Perform NetBIOS enumeration using NetBIOS Enumerator
- Perform NetBIOS enumeration using an NSE Script

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2022 virtual machine
- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 15 Minutes

Overview of NetBIOS Enumeration

NetBIOS stands for Network Basic Input Output System. Windows uses NetBIOS for file and printer sharing. A NetBIOS name is a unique computer name assigned to Windows systems, comprising a 16-character ASCII string that identifies the network device over TCP/IP. The first 15 characters are used for the device name, and the 16th is reserved for the service or name record type.

The NetBIOS service is easily targeted, as it is simple to exploit and runs on Windows systems even when not in use. NetBIOS enumeration allows attackers to read or write to a remote computer system (depending on the availability of shares) or launch a denial of service (DoS) attack.

Lab Tasks

Task 1: Perform NetBIOS Enumeration using Windows Command-Line Utilities

Nbtstat helps in troubleshooting NETBIOS name resolution problems. The nbtstat command removes and corrects preloaded entries using several case-sensitive switches. Nbtstat can be used to enumerate information such as NetBIOS over TCP/IP (NetBT) protocol statistics, NetBIOS name tables for both the local and remote computers, and the NetBIOS name cache.

Net use connects a computer to, or disconnects it from, a shared resource. It also displays information about computer connections.

Here, we will use the Nbtstat, and Net use Windows command-line utilities to perform NetBIOS enumeration on the target network.

Note: Here, we will use the **Windows Server 2019** (10.10.1.19) machine to target a **Windows 11** (10.10.1.11) machine.

1. Turn on the **Windows 11** and **Windows Server 2019** virtual machines.
2. Switch to the **Windows Server 2019** virtual machine. Click **Ctrl+Alt+Del** to activate the machine. By default, **Administrator** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.

   Note: Networks screen appears, click **Yes** to allow your PC to be discoverable by other PCs and devices on the network.
3. Open a **Command Prompt** window.
4. Type **nbtstat -a [IP address of the remote machine]** (in this example, the target IP address is **10.10.1.11**) and press **Enter**.

   Note: In this command, **-a** displays the NetBIOS name table of a remote computer.
5. The result appears, displaying the NetBIOS name table of a remote computer (in this case, the **WINDOWS11** machine), as shown in the screenshot.

```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.17763.1457]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\Administrator>nbtstat -a 10.10.1.11

Ethernet:
Node IpAddress: [10.10.1.19] Scope Id: []

           NetBIOS Remote Machine Name Table

       Name               Type         Status
    ---------------------------------------------
    WORKGROUP       <00>  GROUP       Registered
    WINDOWS11       <00>  UNIQUE      Registered
    WINDOWS11       <20>  UNIQUE      Registered
    WORKGROUP       <1E>  GROUP       Registered
    WORKGROUP       <1D>  UNIQUE      Registered
    ..__MSBROWSE__.<01>  GROUP       Registered

    MAC Address = 1C-89-02-1A-0B-BD

C:\Users\Administrator>_
```

6. In the same **Command Prompt** window, type **nbtstat -c** and press **Enter**.

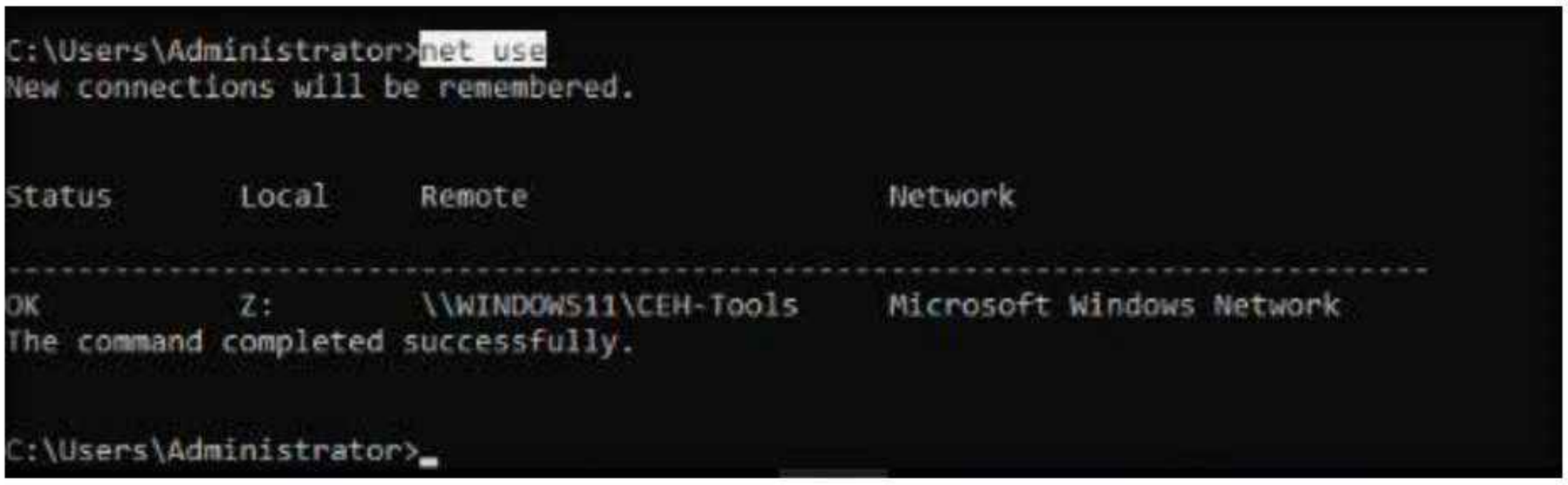
   Note: In this command, **-c** lists the contents of the NetBIOS name cache of the remote computer.

7. The result appears, displaying the contents of the NetBIOS name cache, the table of NetBIOS names, and their resolved IP addresses.

   Note: It is possible to extract this information without creating a **null session** (an unauthenticated session).

```
C:\Users\Administrator>nbtstat -c

Ethernet:
Node IpAddress: [10.10.1.19] Scope Id: []

                NetBIOS Remote Cache Name Table

       Name               Type       Host Address    Life [sec]
    --------------------------------------------------------------
    WINDOW511       <20>  UNIQUE          10.10.1.11          301

C:\Users\Administrator>_
```

8. Now, type **net use** and press **Enter**. The output displays information about the target such as connection status, shared folder/drive and network information, as shown in the screenshot.



9. Using this information, the attackers can read or write to a remote computer system, depending on the availability of shares, or even launch a DoS attack.
10. This concludes the demonstration of performing NetBIOS enumeration using Windows command-line utilities such as Nbtstat and Net use.
11. Close all open windows and document all the acquired information.

Task 2: Perform NetBIOS Enumeration using NetBIOS Enumerator

NetBIOS Enumerator is a tool that enables the use of remote network support and several other techniques such as SMB (Server Message Block). It is used to enumerate details such as NetBIOS names, usernames, domain names, and MAC addresses for a given range of IP addresses.

Here, we will use the NetBIOS Enumerator to perform NetBIOS enumeration on the target network.

Note: Here, we will use the **Windows 11** machine to target **Windows Server 2019** and **Windows Server 2022** machines.

1. Turn on **Windows Server 2022** virtual machine.

   Note: Ensure that the **Windows 11** and **Windows Server 2019** virtual machines are running.

2. Switch to the **Windows 11** virtual machine. By default, **Admin** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.

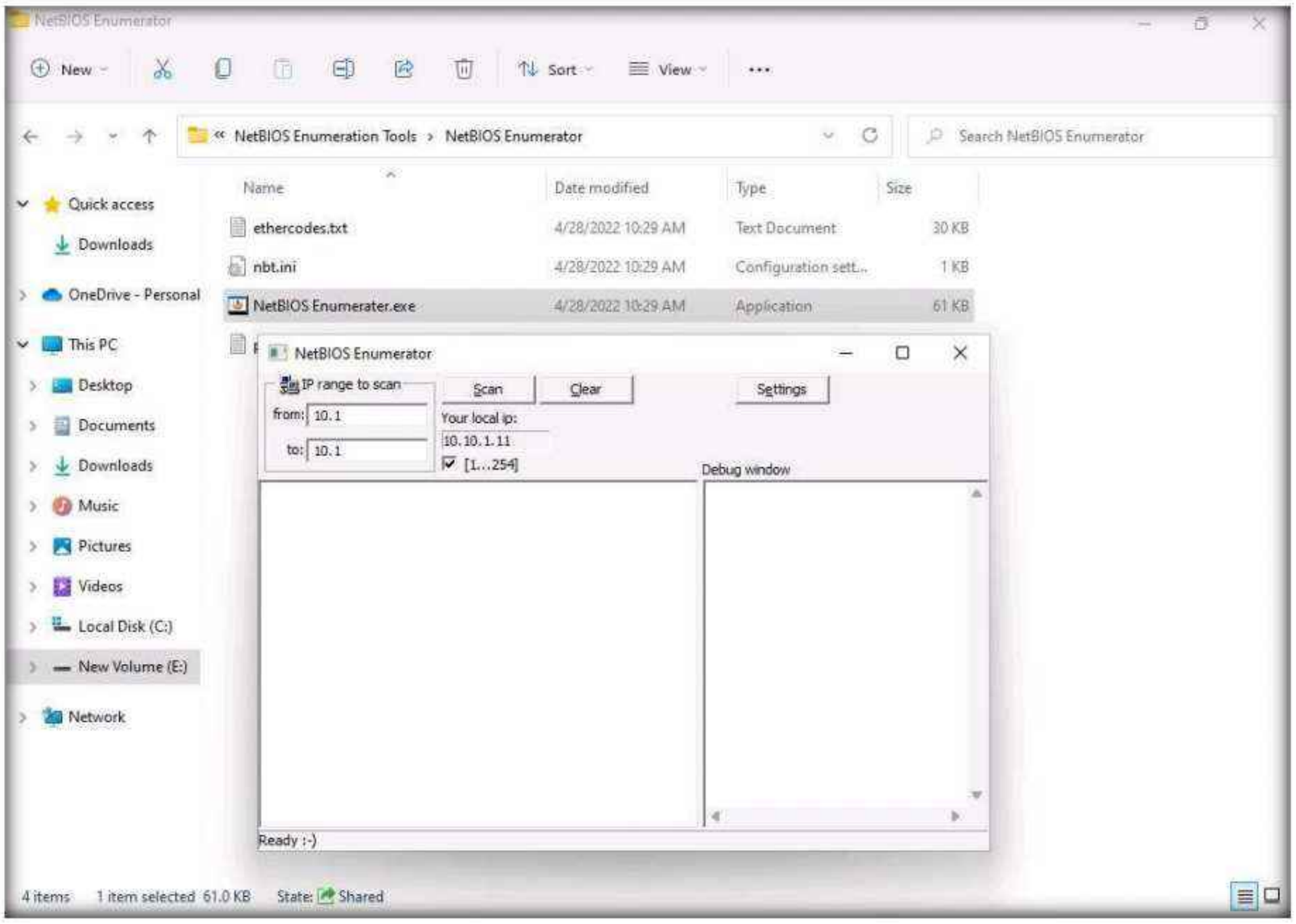
   Note: If **Welcome to Windows** wizard appears, click **Continue** and in **Sign in with Microsoft** wizard, click **Cancel**.

   Note: Networks screen appears, click **Yes** to allow your PC to be discoverable by other PCs and devices on the network.

3. In the **Windows 11** machine, navigate to **E:\CEH-Tools\CEHv12 Module 04 Enumeration\NetBIOS Enumeration Tools\NetBIOS Enumerator** and double-click **NetBIOS Enumerater.exe**.

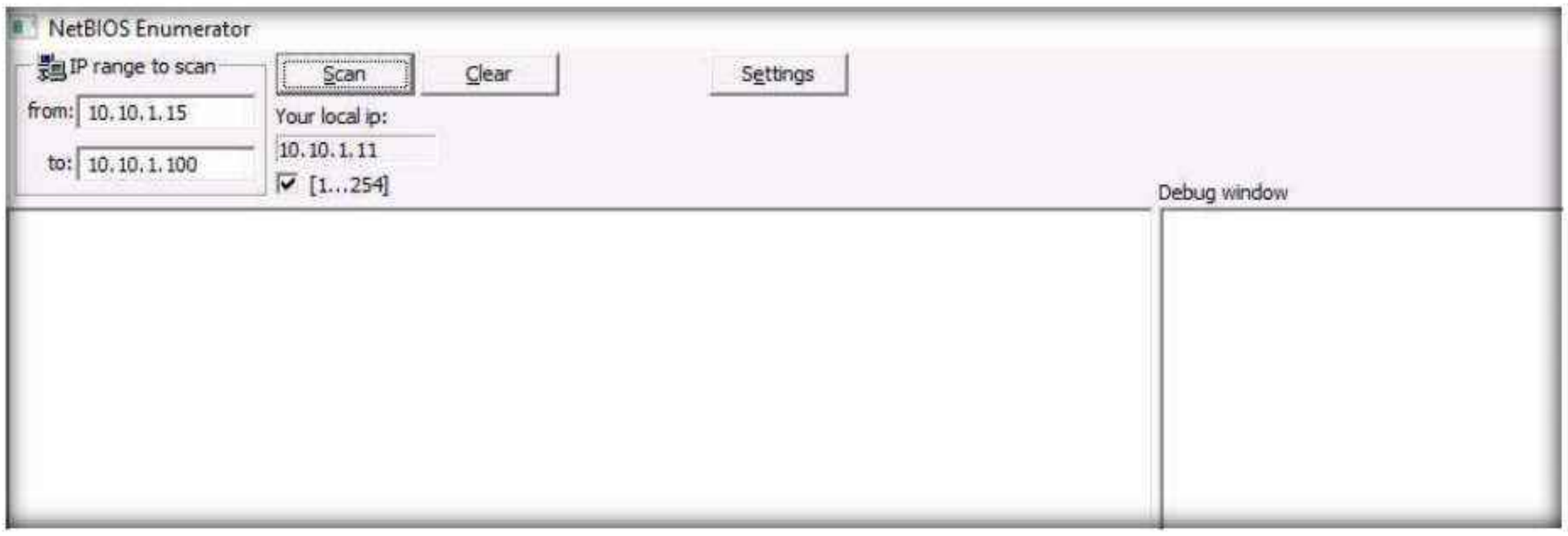
   Note: If the **Open - File Security Warning** pop-up appears, click **Run**.

4. The **NetBIOS Enumerator** main window appears, as shown in the screenshot.



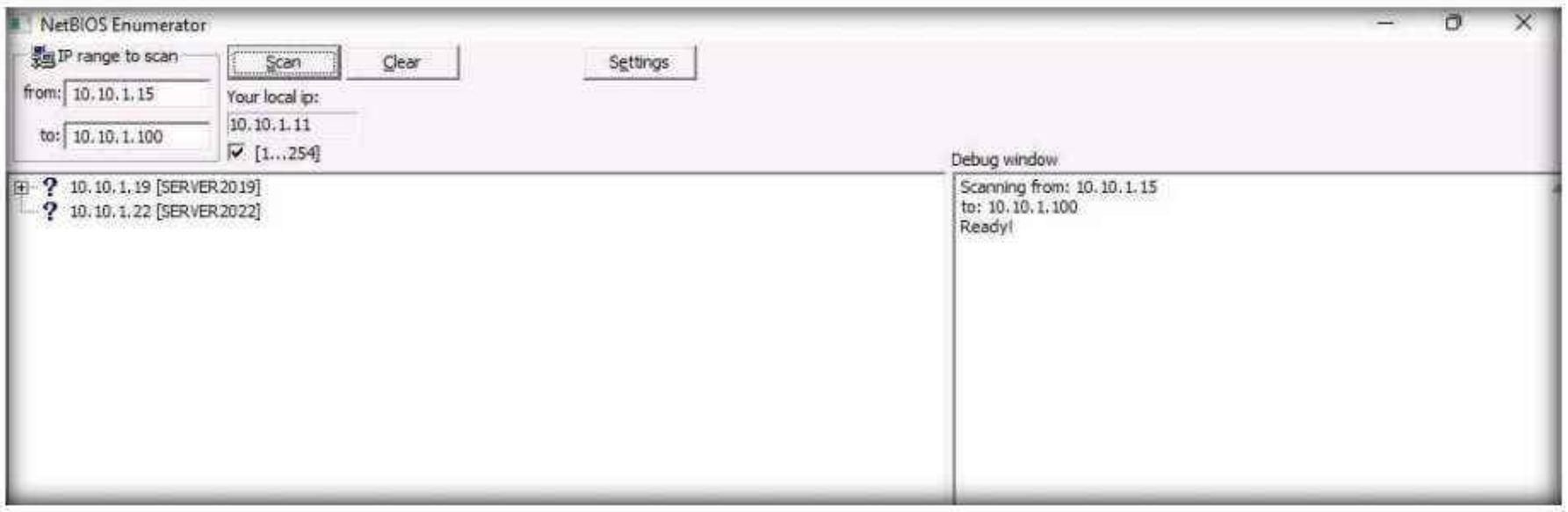
5. Under **IP range to scan**, enter an **IP range** in the **from** and **to** fields and click the **Scan** button to initiate the scan (In this example, we are targeting the IP range **10.10.1.15-10.10.1.100**).

   Note: Ensure that the IP address in **to** field is between 10.10.1.100 to 10.10.1.250. If the IP address is less than 10.10.1.100, the tool might crash.

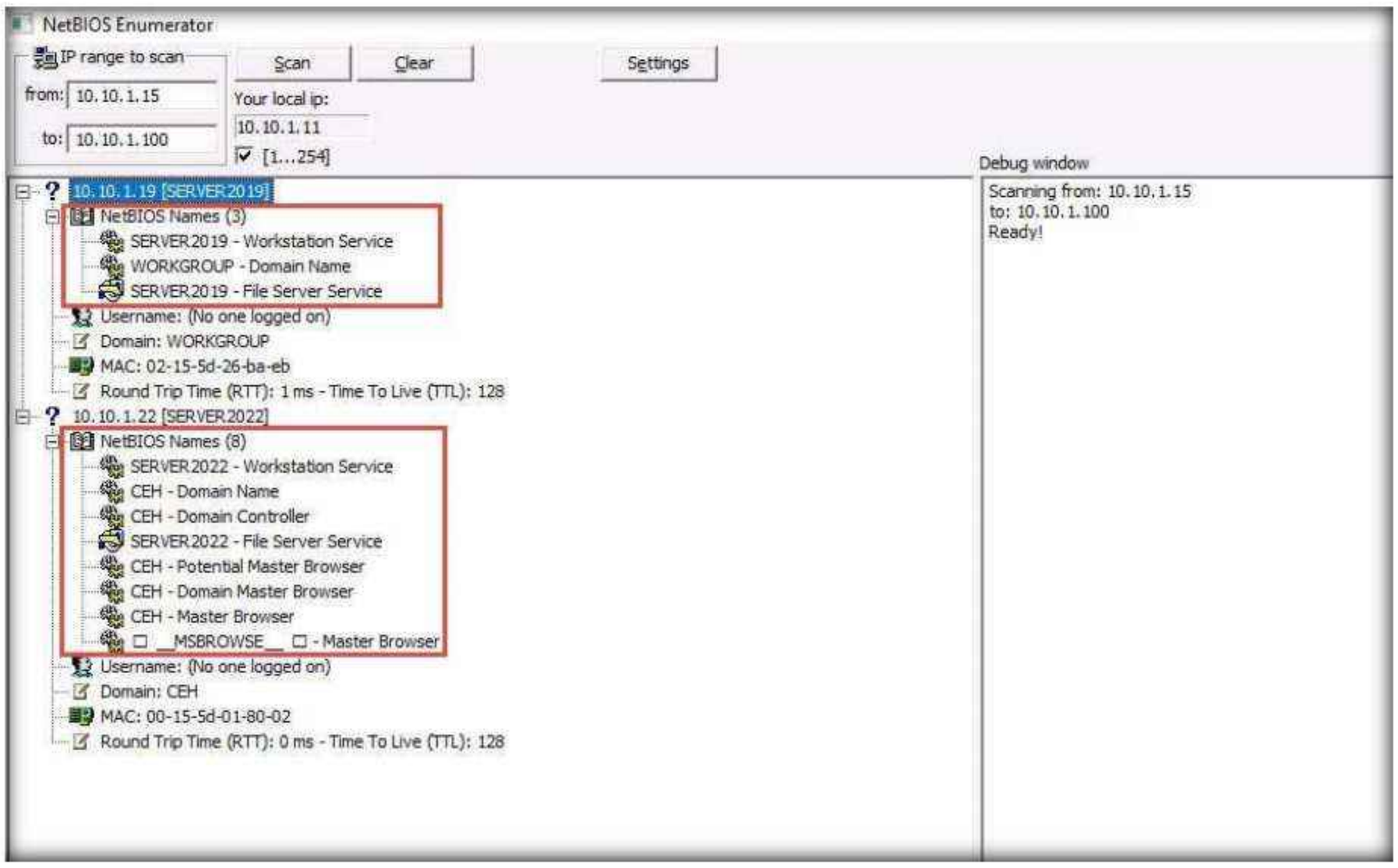


6. NetBIOS Enumerator scans for the provided IP address range. On completion, the scan results are displayed in the left pane, as shown in the screenshot.
7. The **Debug window** section in the right pane shows the scanning range of IP addresses and displays **Ready**! after the scan is finished.

   Note: It takes approximately 5 minutes for the scan to finish.



8. Click on the expand icon (**+**) to the left of the **10.10.1.19** and **10.10.1.22** IP addresses in the left pane of the window. Then click on the expand icon to the left of **NetBIOS Names** to display NetBIOS details of the target IP address, as shown in the screenshot.



9. This concludes the demonstration of performing NetBIOS enumeration using NetBIOS Enumerator. This enumerated NetBIOS information can be used to strategize an attack on the target.
10. Close all open windows and document all the acquired information.
11. Turn off the **Windows 11** and **Windows Server 2019** virtual machines.

Task 3: Perform NetBIOS Enumeration using an NSE Script

NSE allows users to write (and share) simple scripts to automate a wide variety of networking tasks. NSE scripts can be used for discovering NetBIOS shares on the network. Using the nbstat NSE script, for example, you can retrieve the target's NetBIOS names and MAC addresses. Moreover, increasing verbosity allows you to extract all names related to the system.

Here, we will run the nbstat script to enumerate information such as the name of the computer and the logged-in user.

Note: Ensure that the **Windows Server 2022** virtual machine is running.

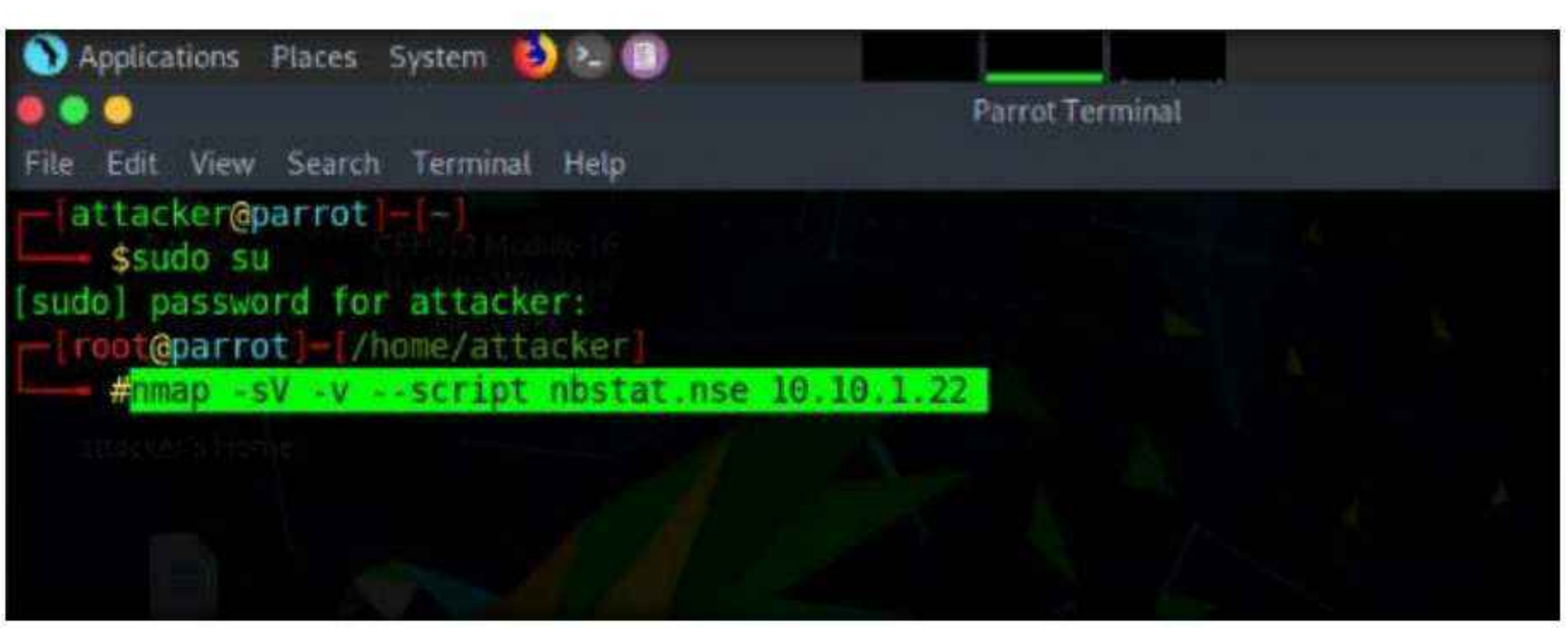
1. Turn on the **Parrot Security** virtual machine.
2. In the login page, the **attacker** username will be selected by default. Enter password as **toor** in the **Password** field and press **Enter** to log in to the machine.

   Note: If a **Parrot Updater** pop-up appears at the top-right corner of **Desktop**, ignore and close it.

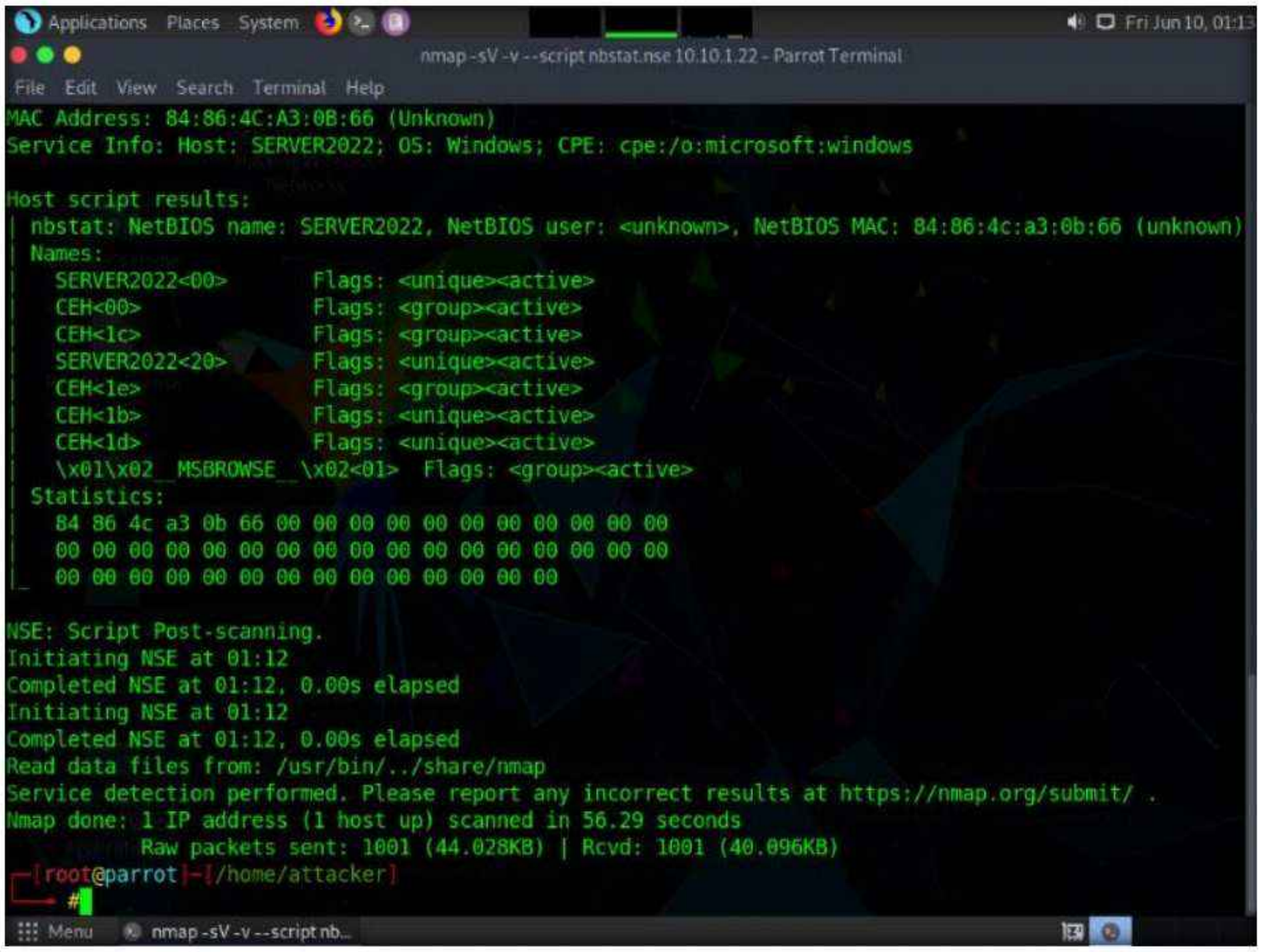
   Note: If a **Question** pop-up window appears asking you to update the machine, click **No** to close the window.
3. Click the **MATE Terminal** icon at the top of the **Desktop** to open a **Terminal** window.
4. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
5. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.
6. In the terminal window, type **nmap -sV -v --script nbstat.nse [Target IP Address]** (in this example, the target IP address is **10.10.1.22**) and press **Enter**.

   Note: **-sV** detects the service versions, **-v** enables the verbose output (that is, includes all hosts and ports in the output), and **--script nbstat.nse** performs the NetBIOS enumeration.

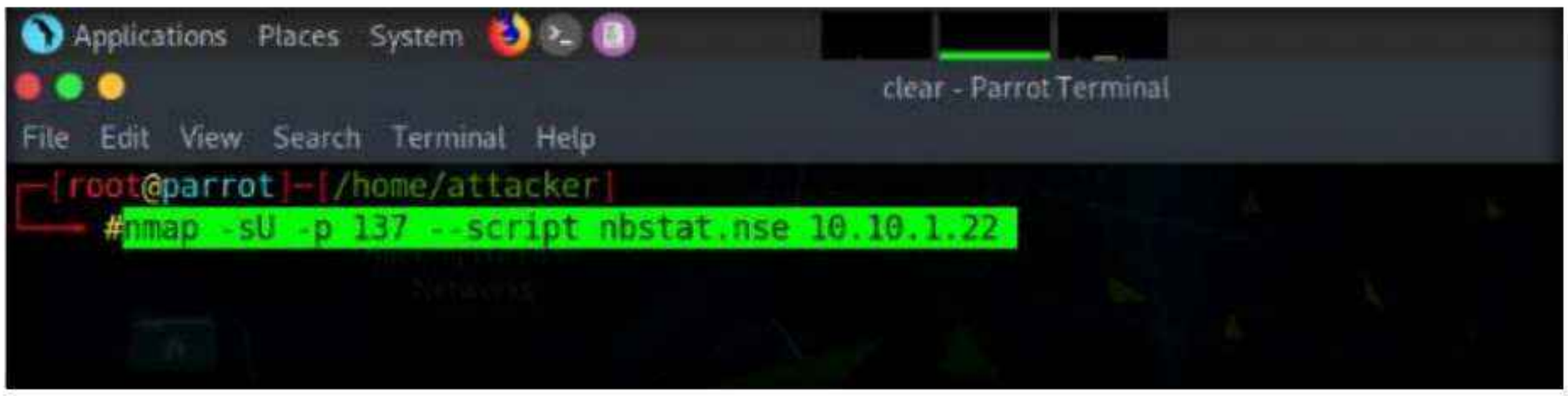


7. The scan results appear, displaying the open ports and services, along with their versions. Displayed under the **Host script results** section are details about the target system such as the NetBIOS name, NetBIOS user, and NetBIOS MAC address, as shown in the screenshot.

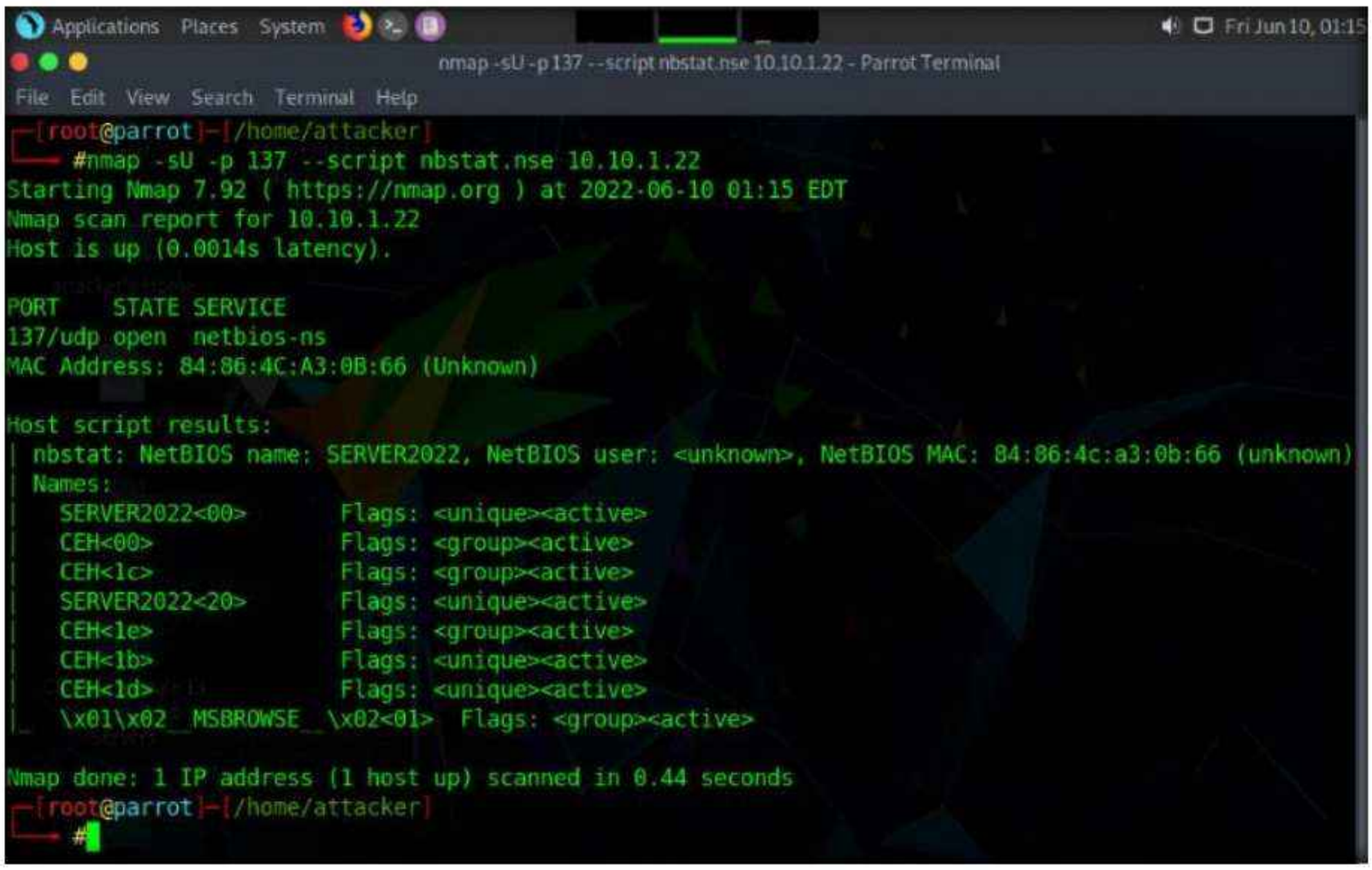


8. In the terminal window, type **nmap -sU -p 137 --script nbstat.nse [Target IP Address]** (in this case, the target IP address is **10.10.1.22**) and press **Enter**.

   Note: **-sU** performs a UDP scan, **-p** specifies the port to be scanned, and **--script nbstat.nse** performs the NetBIOS enumeration.



9. The scan results appear, displaying the open NetBIOS port (137) and, under the **Host script results** section, NetBIOS details such as NetBIOS name, NetBIOS user, and NetBIOS MAC of the target system, as shown in the screenshot.



10. This concludes the demonstration of performing NetBIOS enumeration using an NSE script.
11. Other tools may also be used to perform NetBIOS enumeration on the target network such as **Global Network Inventory** (http://www.magnetosoft.com), **Advanced IP Scanner** (https://www.advanced-ip-scanner.com), **Hyena** (https://www.systemtools.com), and **Nsauditor Network Security Auditor** (https://www.nsauditor.com).
12. Close all open windows and document all the acquired information.
13. Turn off the **Parrot Security** and **Windows Server 2022** virtual machines.

Lab Analysis

Analyze and document the results of this lab exercise.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Internet Connection Required	
☐ Yes	☑ No
Platform Supported	
☑ Classroom	☑ CyberQ

Lab 2

Perform SNMP Enumeration

SNMP enumeration uses SNMP to obtain a list of user accounts and devices on a target system.

Lab Scenario

As a professional ethical hacker or penetration tester, your next step is to carry out SNMP enumeration to extract information about network resources (such as hosts, routers, devices, and shares) and network information (such as ARP tables, routing tables, device-specific information, and traffic statistics).

Using this information, you can further scan the target for underlying vulnerabilities, build a hacking strategy, and launch attacks.

Lab Objectives

- Perform SNMP enumeration using snmp-check
- Perform SNMP enumeration using SoftPerfect Network Scanner
- Perform SNMP enumeration using SnmpWalk
- Perform SNMP enumeration using Nmap

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2022 virtual machine
- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Ubuntu virtual machine
- Android virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 20 Minutes

Overview of SNMP Enumeration

SNMP (Simple Network Management Protocol) is an application layer protocol that runs on UDP (User Datagram Protocol) and maintains and manages routers, hubs, and switches on an IP network. SNMP agents run on networking devices on Windows and UNIX networks.

SNMP enumeration uses SNMP to create a list of the user accounts and devices on a target computer. SNMP employs two types of software components for communication: the SNMP agent and SNMP management station. The SNMP agent is located on the networking device, and the SNMP management station communicates with the agent.

Lab Tasks

Task 1: Perform SNMP Enumeration using snmp-check

snmp-check is a tool that enumerates SNMP devices, displaying the output in a simple and reader-friendly format. The default community used is "public." As an ethical hacker or penetration tester, it is imperative that you find the default community strings for the target device and patch them up.

Here, we will use the snmp-check tool to perform SNMP enumeration on the target IP address

Note: We will use the **Parrot Security** (10.10.1.13) machine to target the **Windows Server 2022** (10.10.1.22) machine.

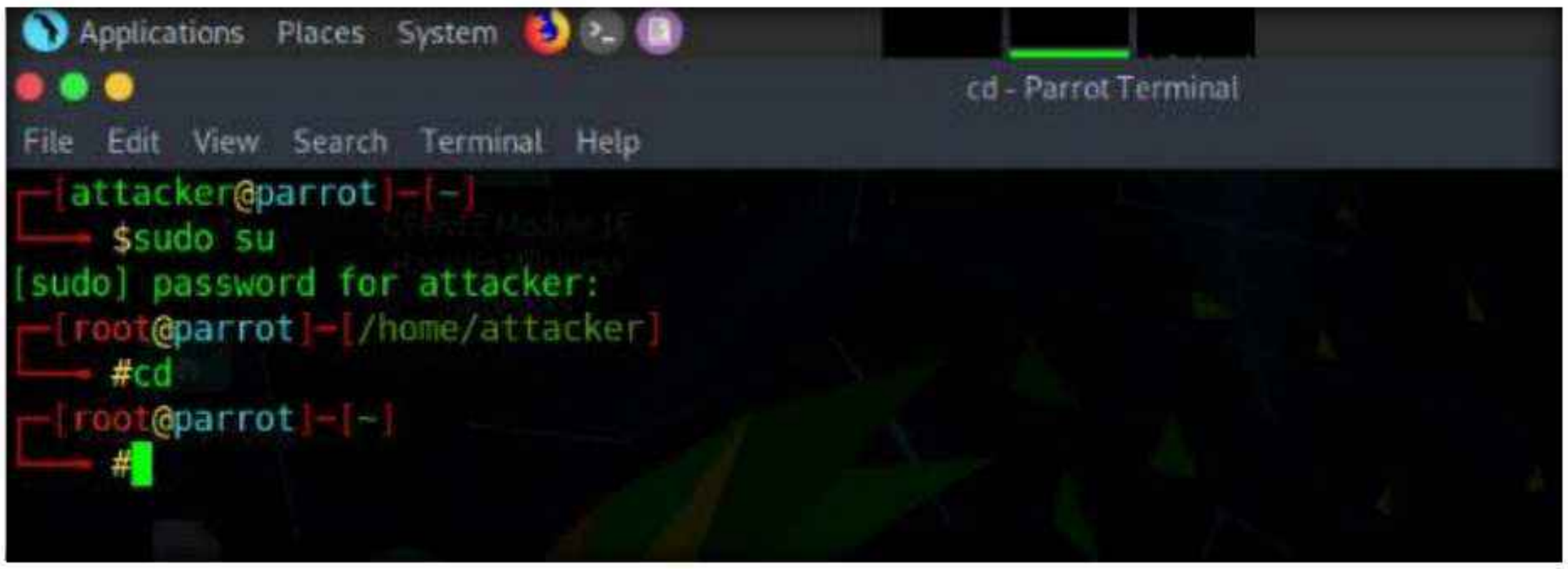
1. Turn on the **Parrot Security** and **Windows Server 2022** virtual machines.
2. In the login page, the **attacker** username will be selected by default. Enter password as **toor** in the **Password** field and press **Enter** to log in to the machine.

   Note: If a **Parrot Updater** pop-up appears at the top-right corner of **Desktop**, ignore and close it.

   Note: If a **Question** pop-up window appears asking you to update the machine, click **No** to close the window.
3. Click the **MATE Terminal** icon at the top of the **Desktop** to open a **Terminal** window.

   Note: Before starting SNMP enumeration, we must first discover whether the SNMP port is open. SNMP uses port 161 by default; to check whether this port is opened, we will first run Nmap port scan.
4. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
5. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

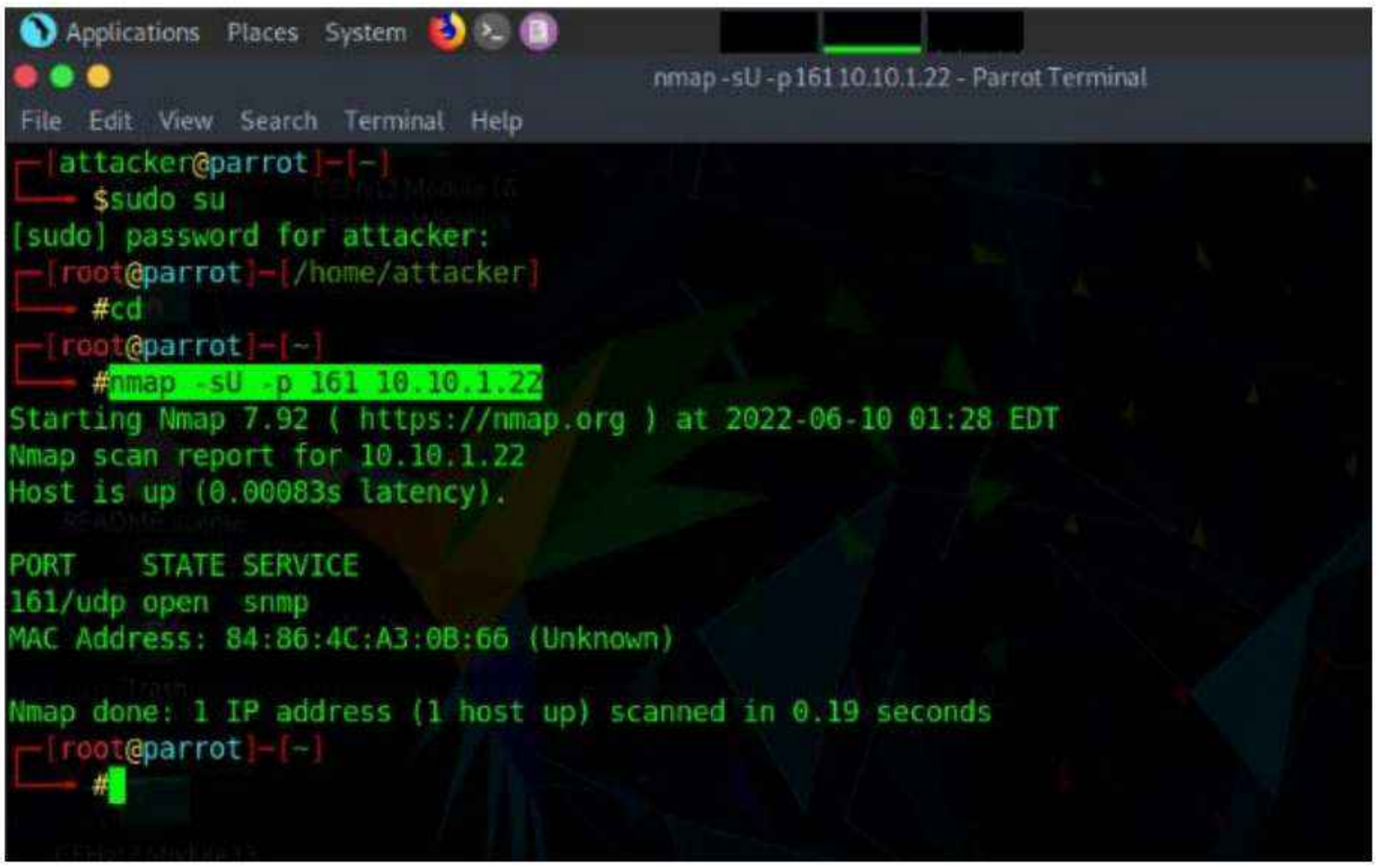
   Note: The password that you type will not be visible.
6. Now, type **cd** and press **Enter** to jump to the root directory.



7. In the **Parrot Terminal** window, type **nmap -sU -p 161 [Target IP address]** (in this example, the target IP address is **10.10.1.22**) and press **Enter**.

   Note: **-sU** performs a UDP scan and **-p** specifies the port to be scanned.

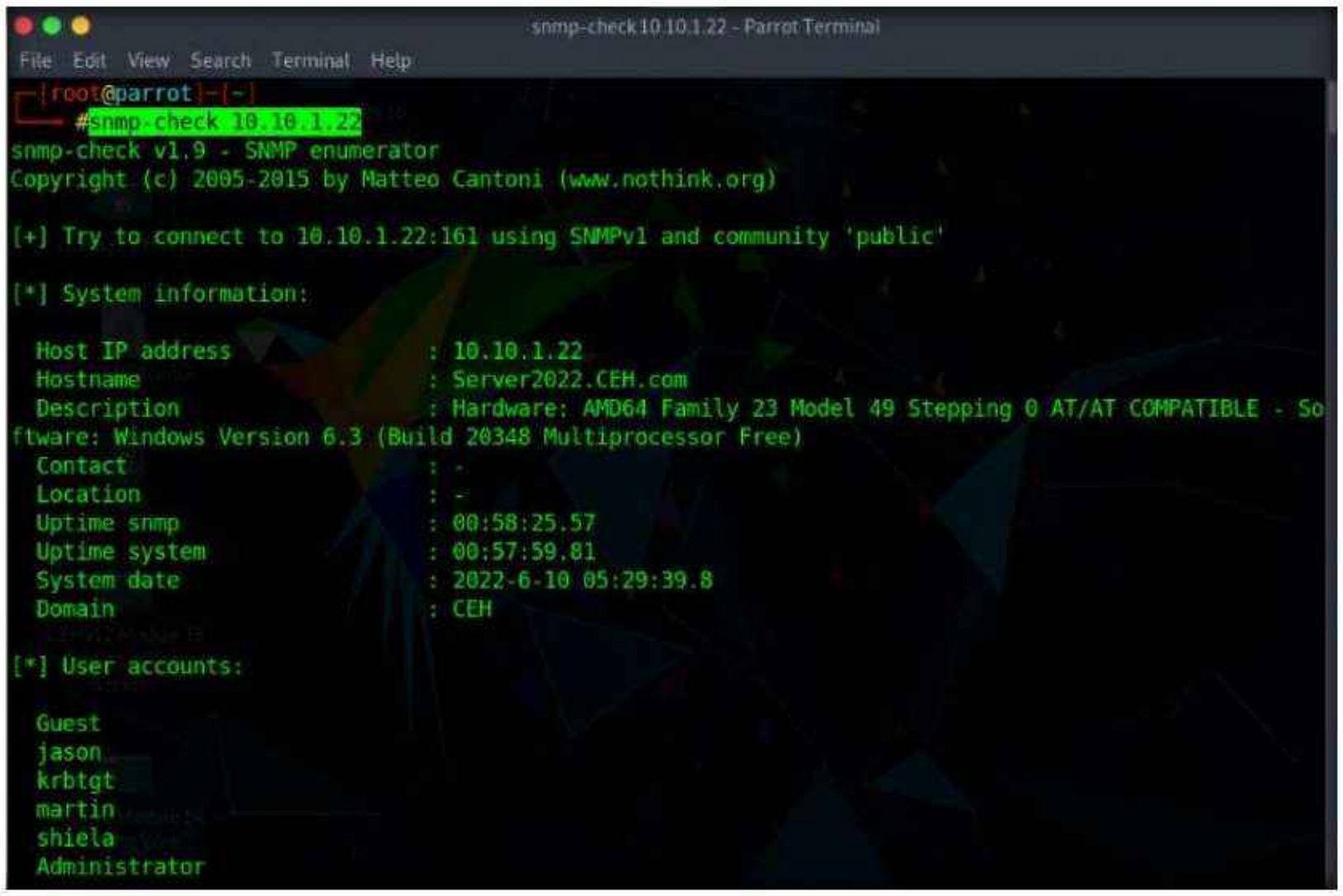
8. The results appear, displaying that port 161 is **open** and being used by SNMP, as shown in the screenshot.



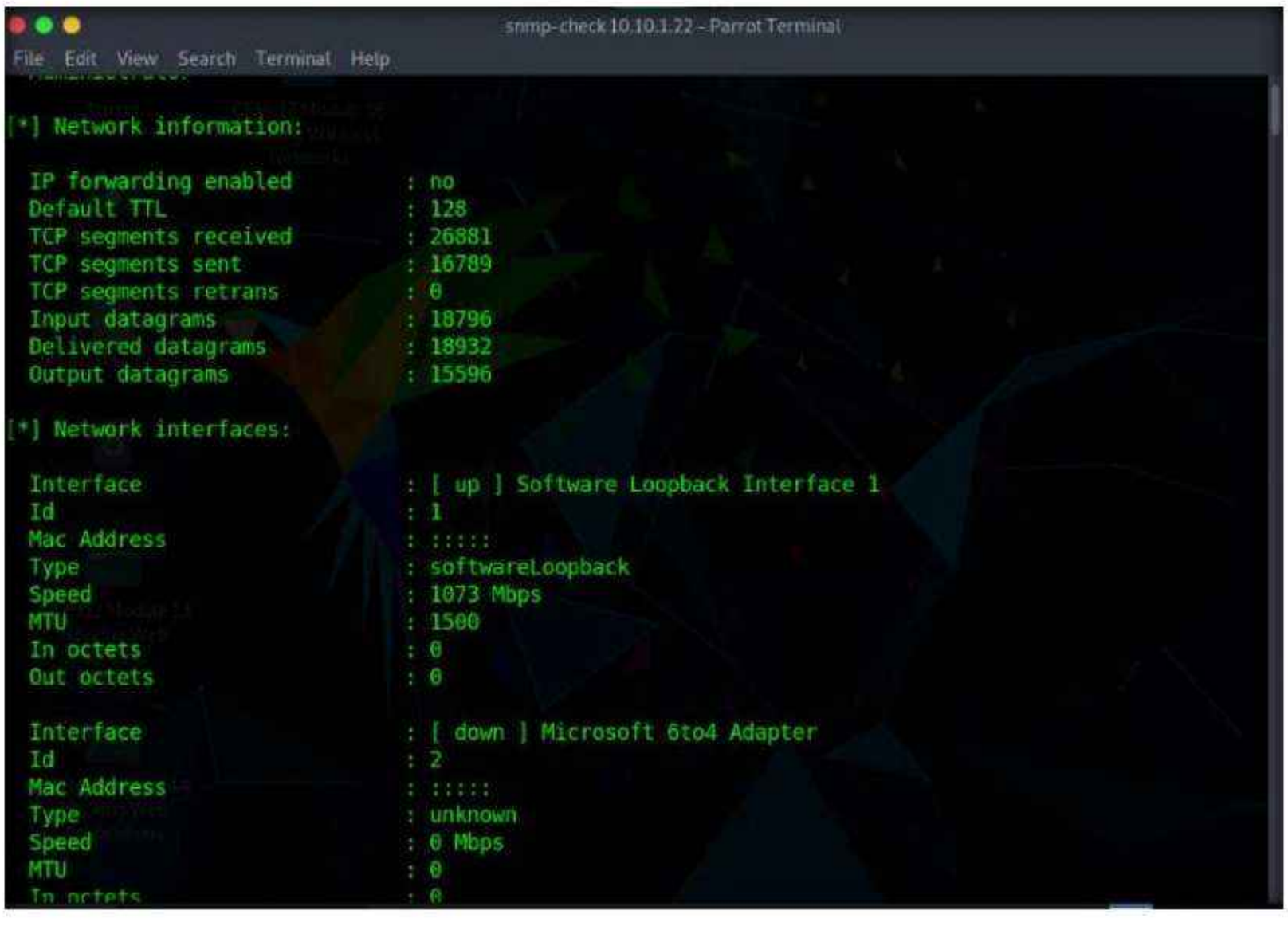
9. We have established that the SNMP service is running on the target machine. Now, we shall exploit it to obtain information about the target system.
10. In the **Parrot Terminal** window, type **snmp-check [Target IP Address]** (in this example, the target IP address is **10.10.1.22**) and press **Enter**.
11. The result appears as shown in the screenshot. It reveals that the extracted SNMP port 161 is being used by the default “public” community string.

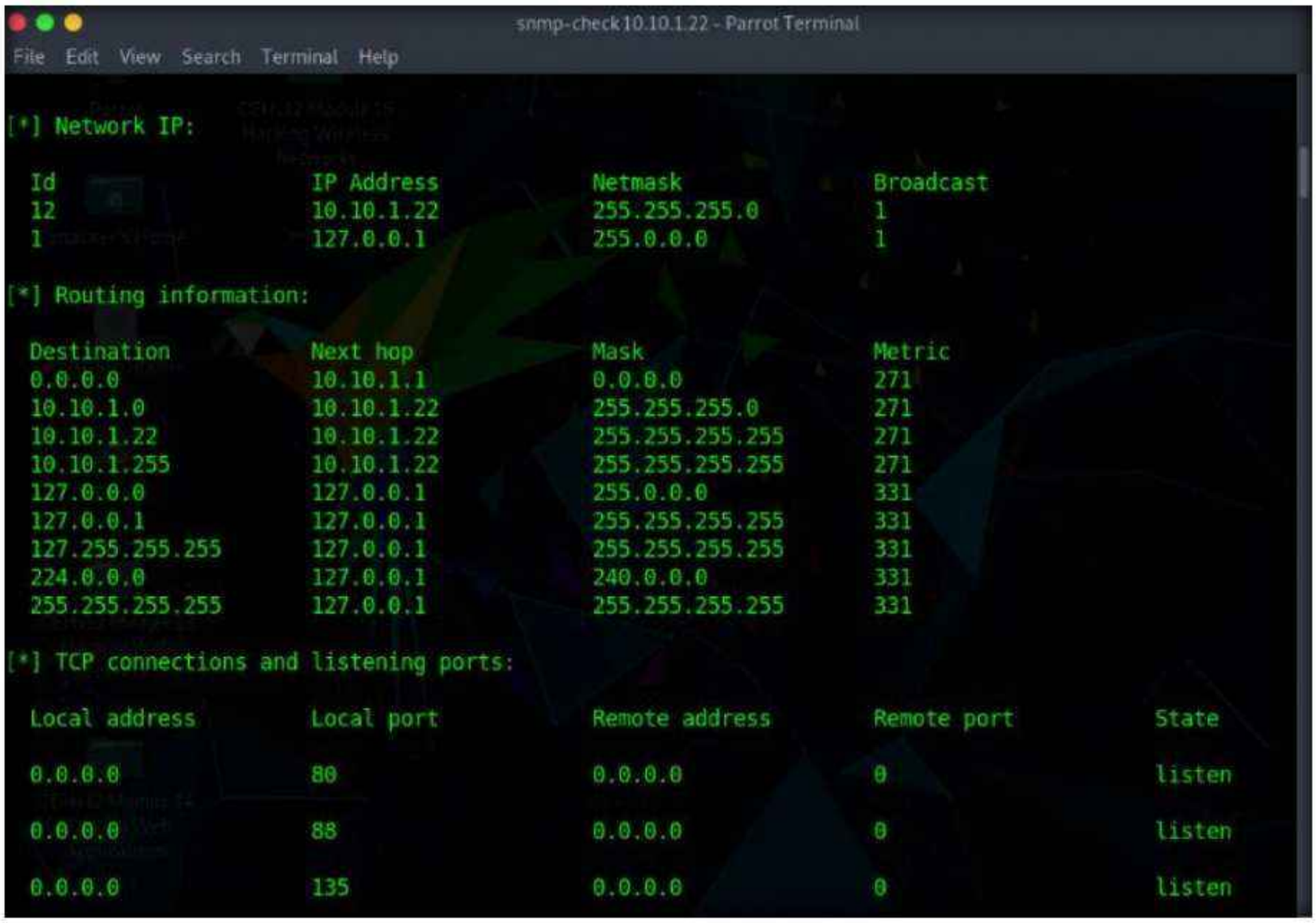
    Note: If the target machine does not have a valid account, no output will be displayed.

12. The snmp-check command enumerates the target machine, listing sensitive information such as **System information** and **User accounts**.

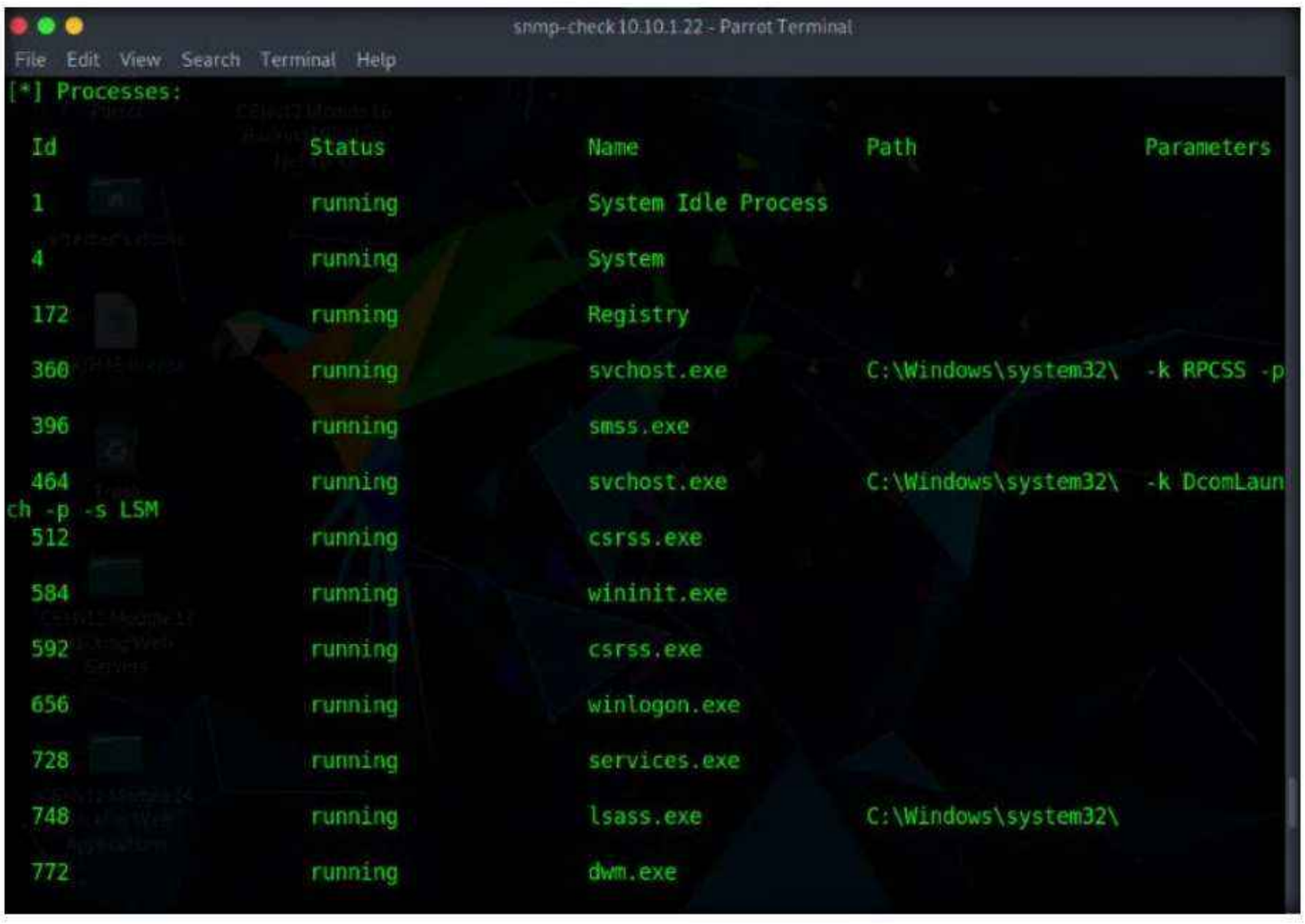


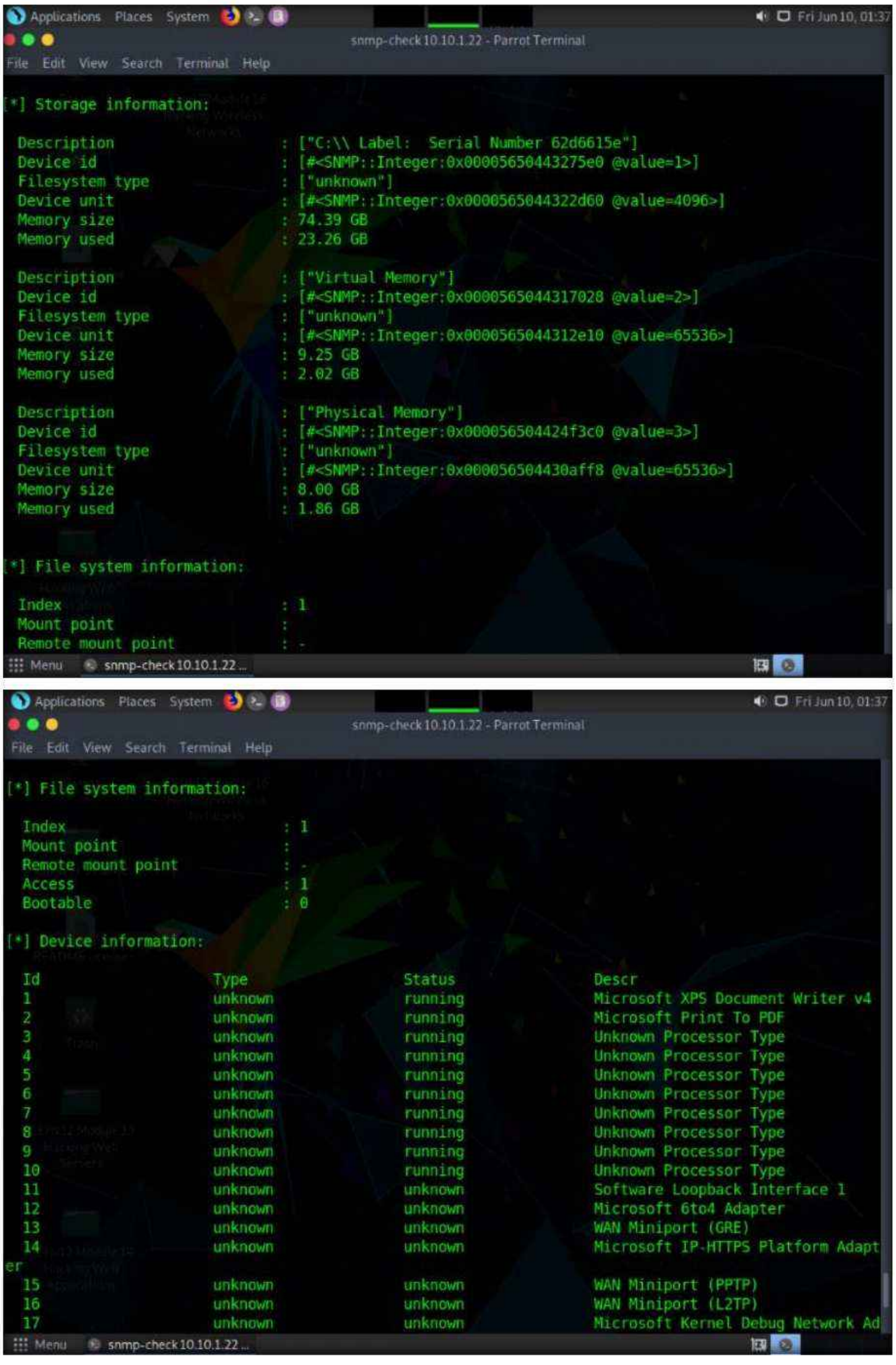
13. Scroll down to view detailed information regarding the target network under the following sections: **Network information**, **Network interfaces**, **Network IP** and **Routing information**, and **TCP connections** and **listening ports**.

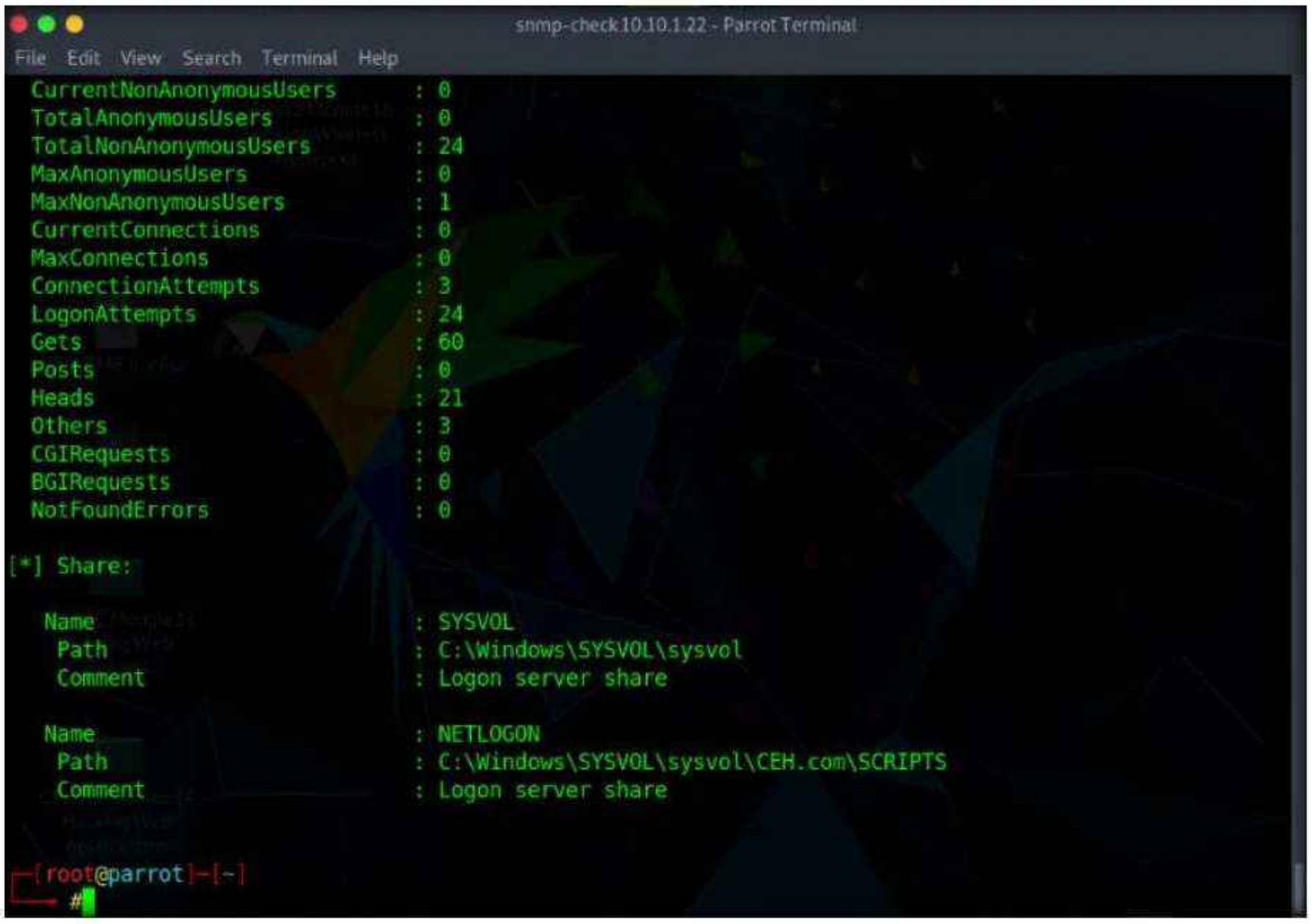




14. Similarly, scrolling down reveals further sensitive information on **Processes**, **Storage information**, **File system information**, **Device information**, **Share**, etc.







15. Attackers can further use this information to discover vulnerabilities in the target machine and further exploit them to launch attacks.
16. This concludes the demonstration of performing SNMP enumeration using the snmp-check.
17. Close all open windows and document all the acquired information.

Task 2: Perform SNMP Enumeration using SoftPerfect Network Scanner

SoftPerfect Network Scanner can ping computers, scan ports, discover shared folders, and retrieve practically any information about network devices via WMI (Windows Management Instrumentation), SNMP, HTTP, SSH, and PowerShell.

The program also scans for remote services, registries, files, and performance counters. It can check for a user-defined port and report if one is open, and is able to resolve hostnames as well as auto-detect your local and external IP range. SoftPerfect Network Scanner offers flexible filtering and display options, and can export the NetScan results to a variety of formats, from XML to JSON. In addition, it supports remote shutdown and Wake-On-LAN.

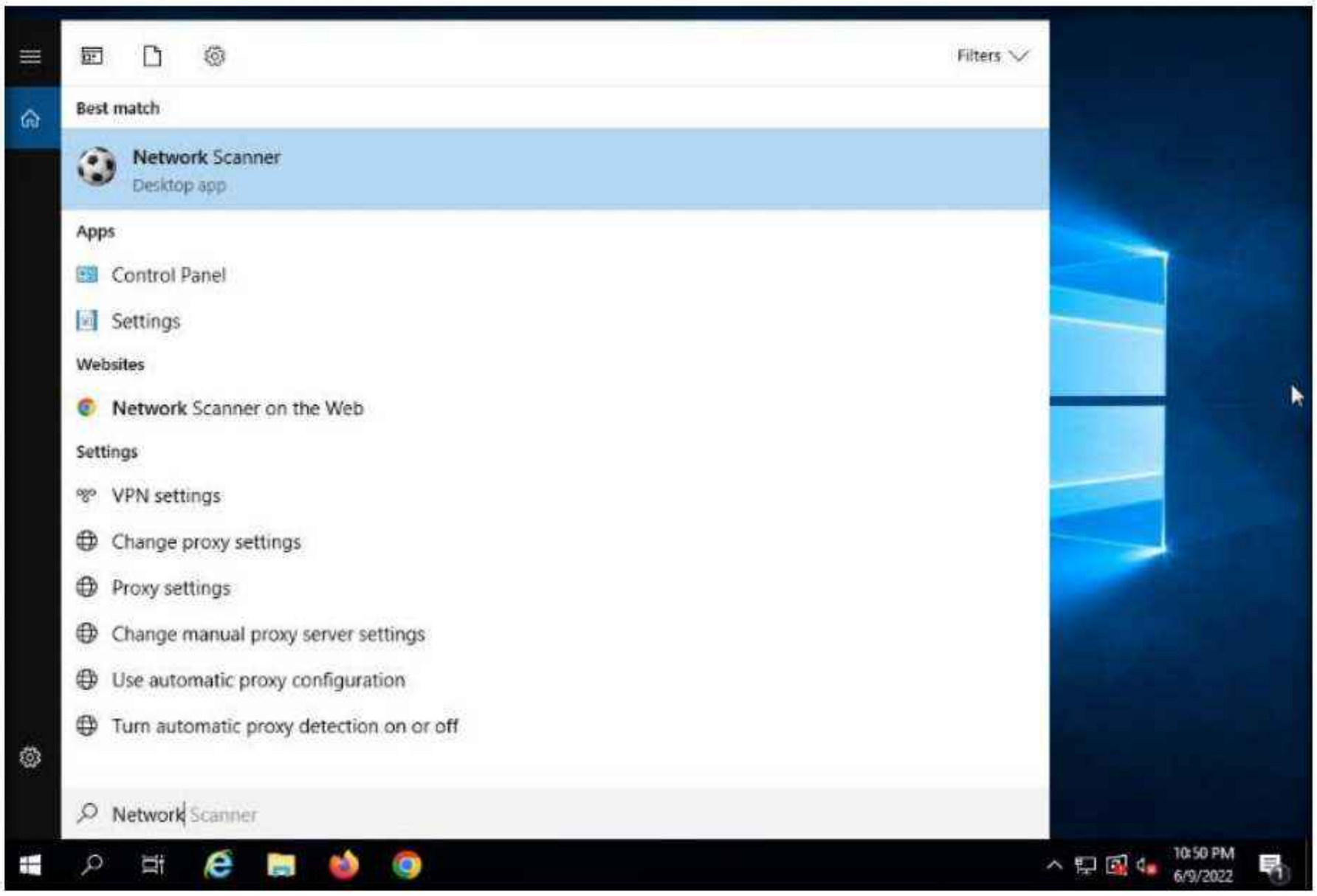
Here, we will use the SoftPerfect Network Scanner to perform SNMP enumeration on a target system.

Note: Ensure that the **Parrot Security** and **Windows Server 2022** virtual machines are running.

1. Turn on the **Windows 11**, **Windows Server 2019**, **Ubuntu** and **Android** virtual machines.
2. Switch to the **Windows Server 2019** virtual machine. Click **Ctrl+Alt+Del**, then login into **Administrator** user profile using **Pa$$w0rd** as password.

Note: Networks screen appears, click **Yes** to allow your PC to be discoverable by other PCs and devices on the network

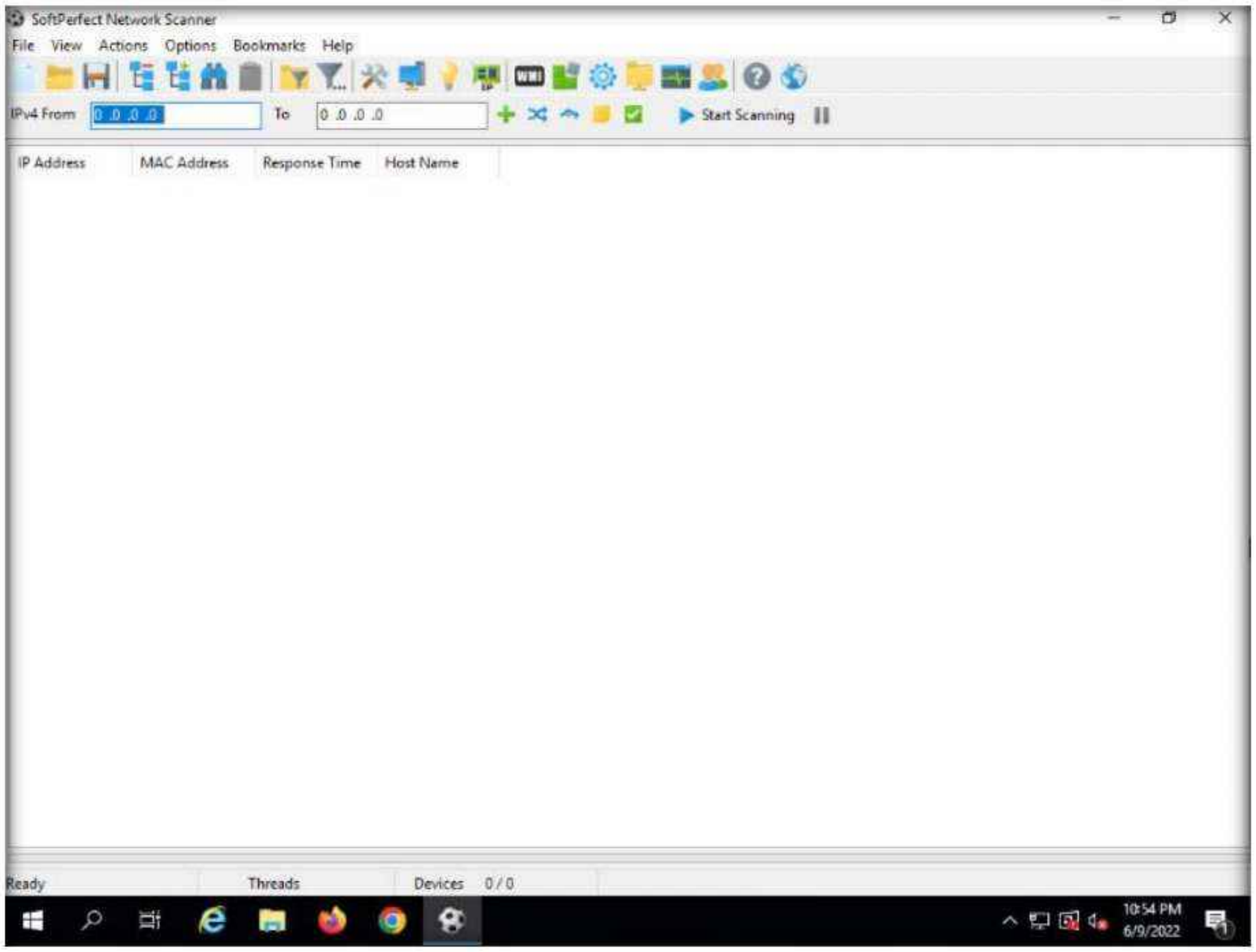
3. Click **Search** icon () on the **Desktop**. Type **network** in the search field, the **Network Scanner** appears in the results, select **Network Scanner** to launch it.



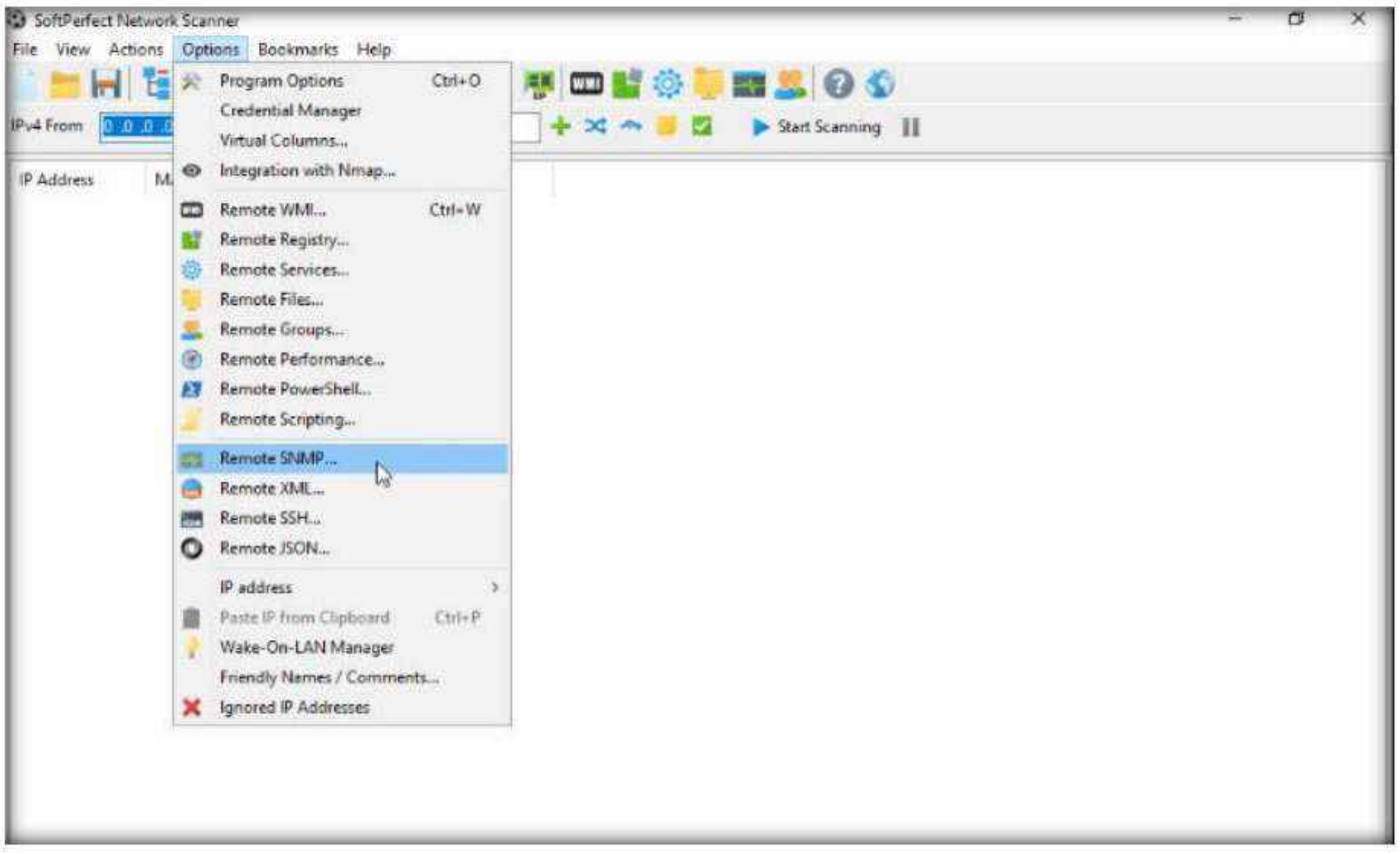
Note: If a **User Account Control** pop-up appears, click **Yes**.

4. When the **Welcome to the Network Scanner!** wizard appears, click **Continue**.

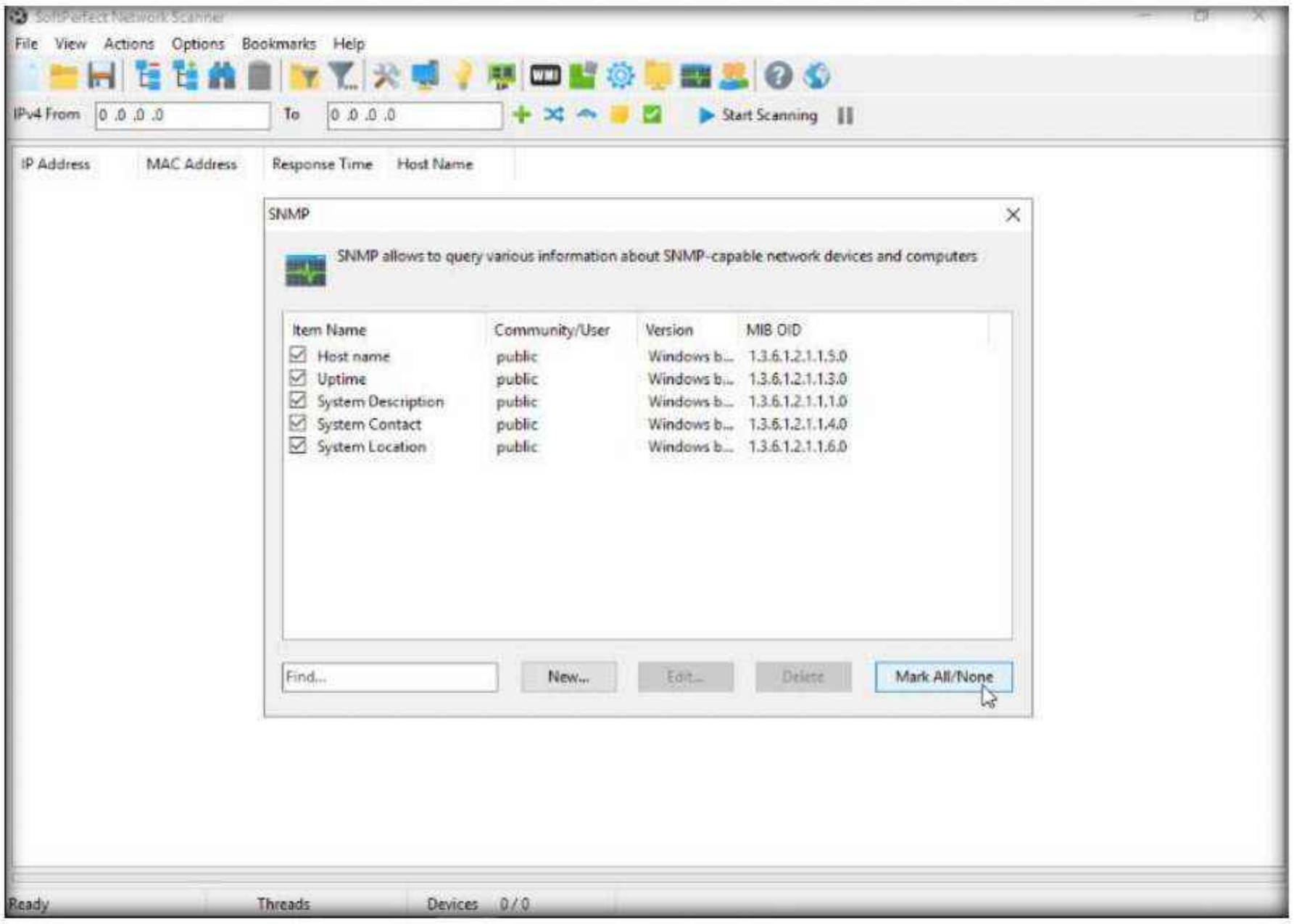
5. The **SoftPerfect Network Scanner** GUI window will appear, as shown in the screenshot.



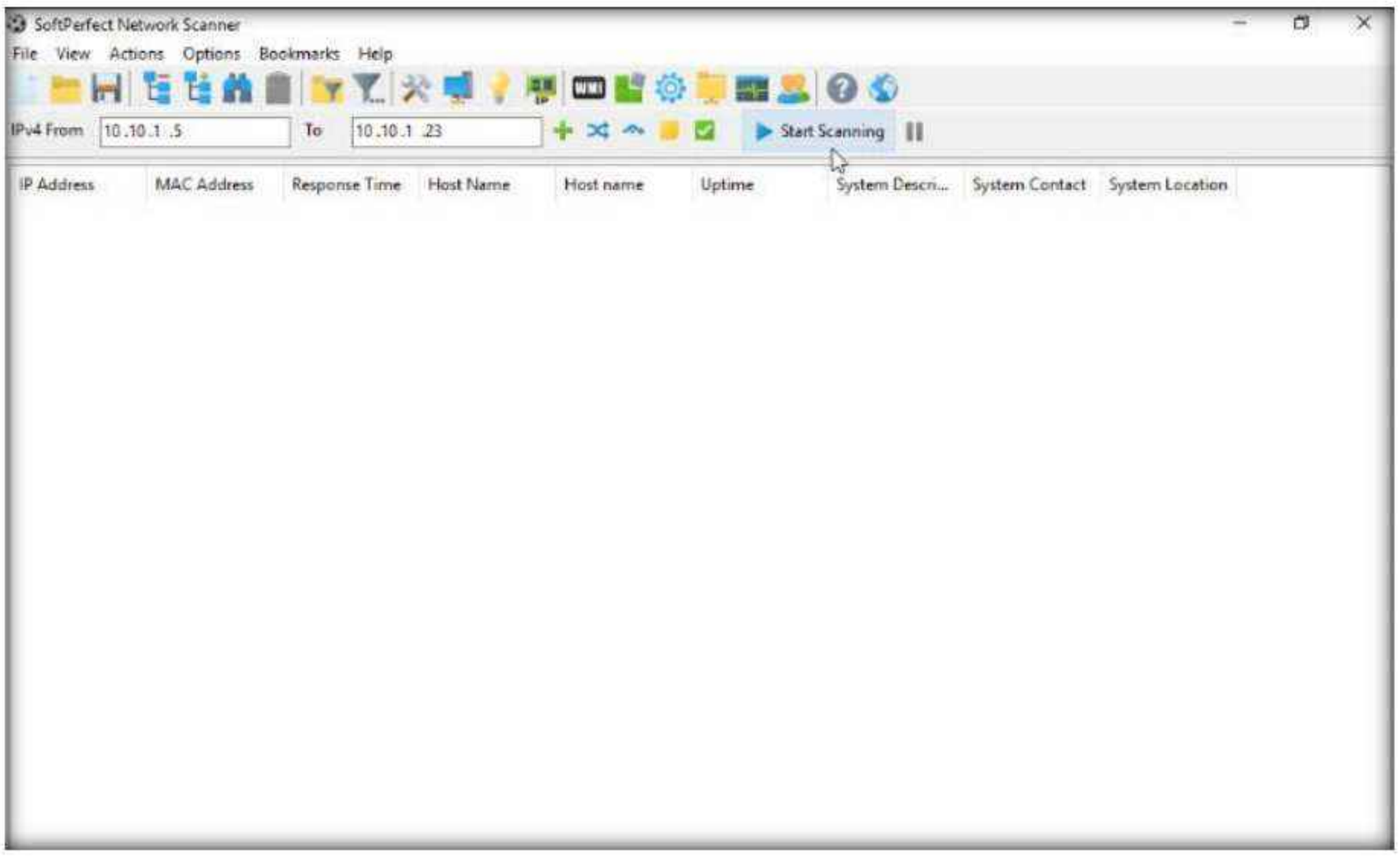
6. Click on the **Options** menu, and select **Remote SNMP…** from the drop down list. The **SNMP** pop-up window will appear.



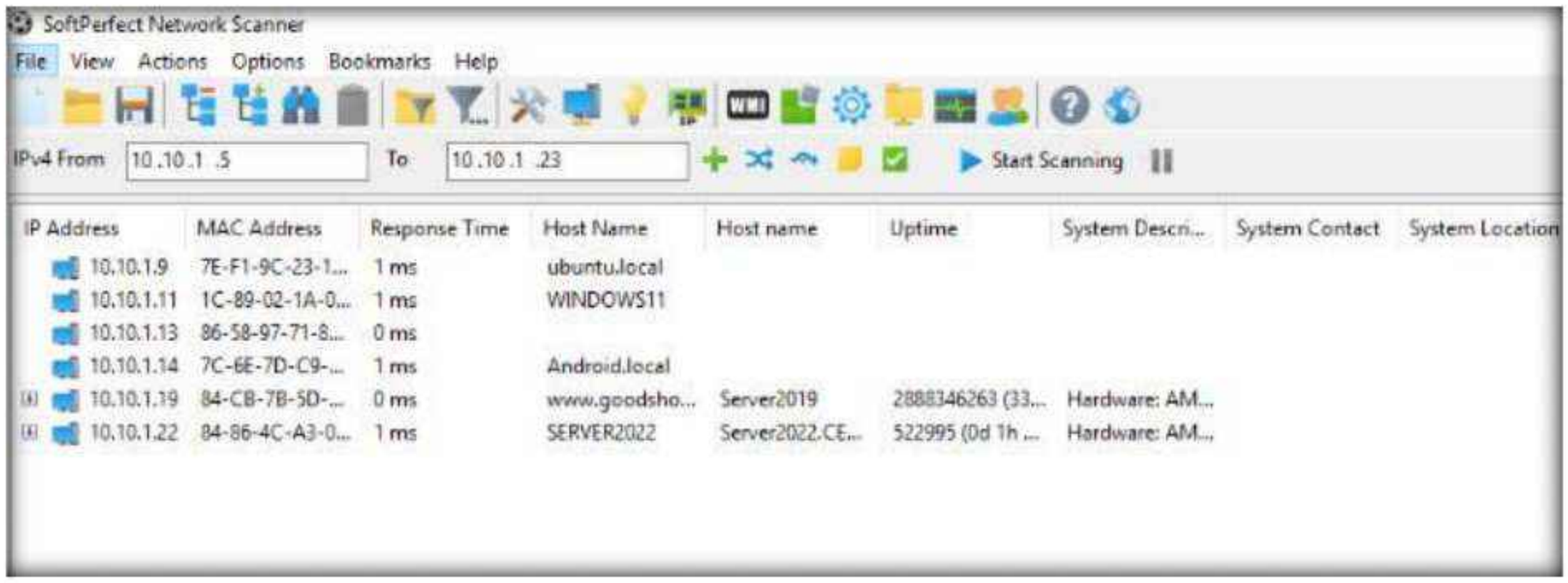
7. Click the **Mark All/None** button to select all the items available for SNMP scanning and close the window.



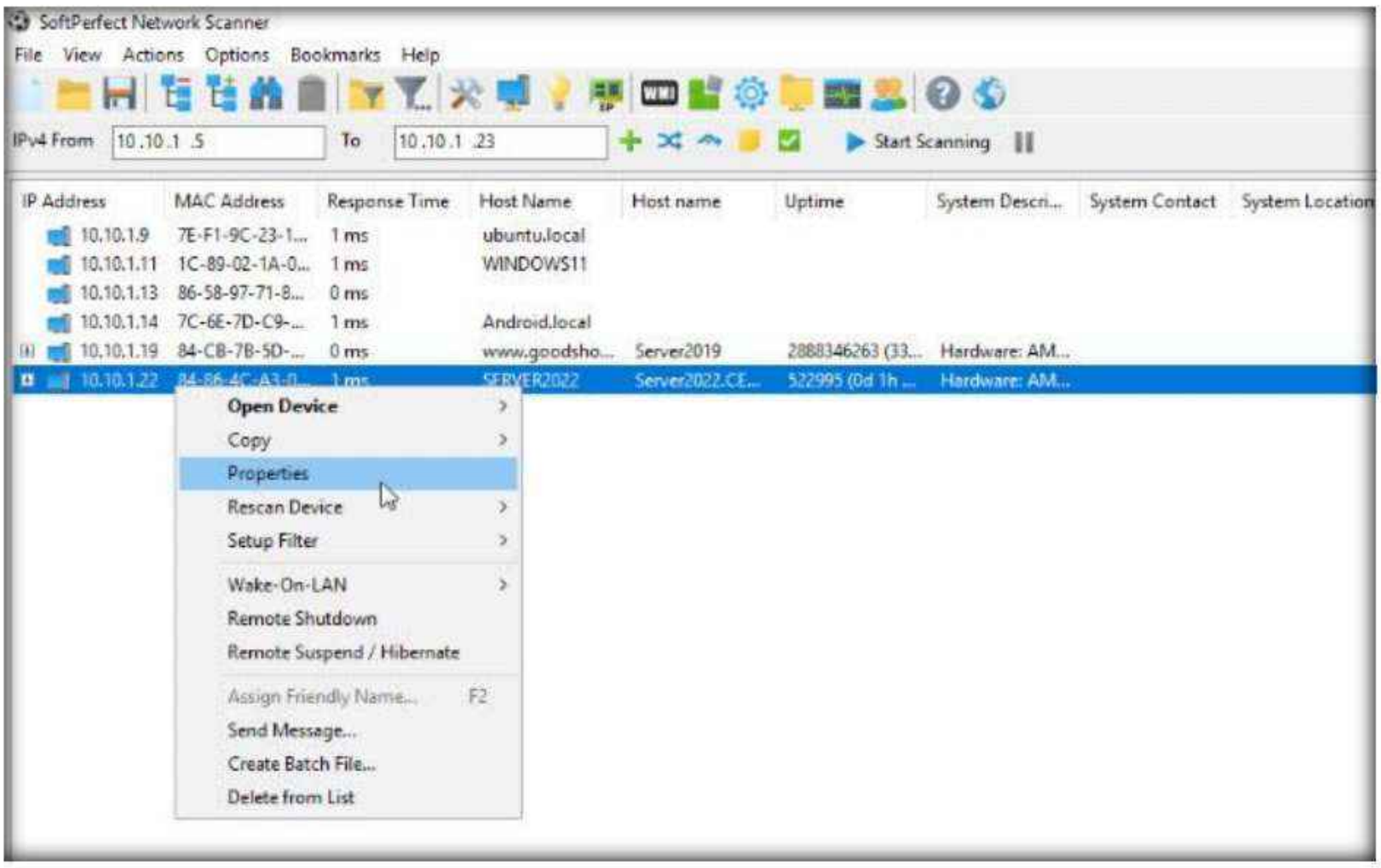
8. To scan your network, enter an IP range in the **IPv4 From** and **To** fields (in this example, the target IP address range is **10.10.1.5-10.10.1.23**), and click the **Start Scanning** button.



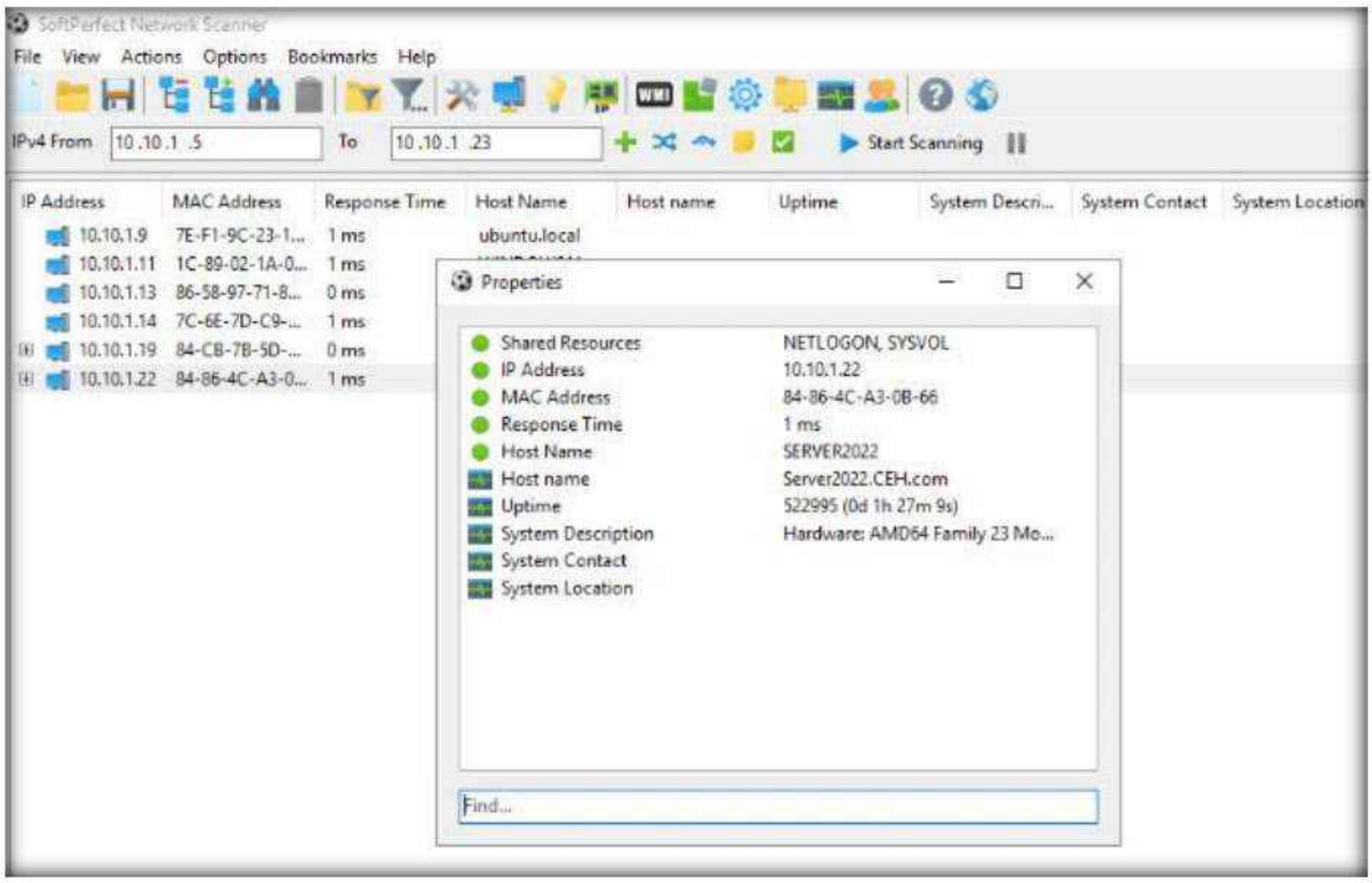
9. The **status bar** at the lower-right corner of the GUI displays the status of the scan.
10. The scan results appear, displaying the active hosts in the target IP address range, as shown in the screenshot.



11. To view the properties of an individual IP address, right-click a particular IP address (in this example, **10.10.1.22**) and select **Properties**, as shown in the screenshot.



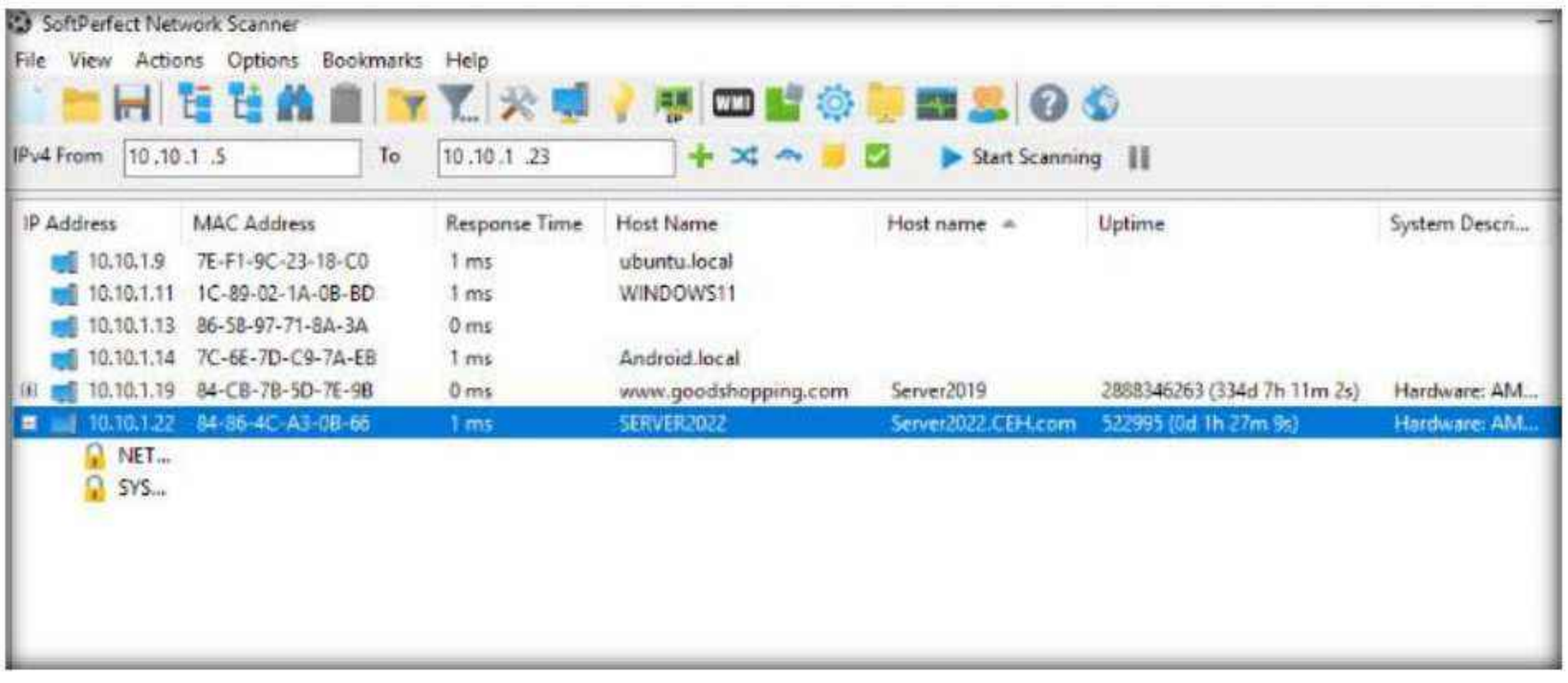
12. The **Properties** window appears, displaying the **Shared Resources**, **IP Address**, **MAC Address**, **Response Time**, **Host Name**, **Uptime**, and **System Description** of the machine corresponding to the selected IP address.



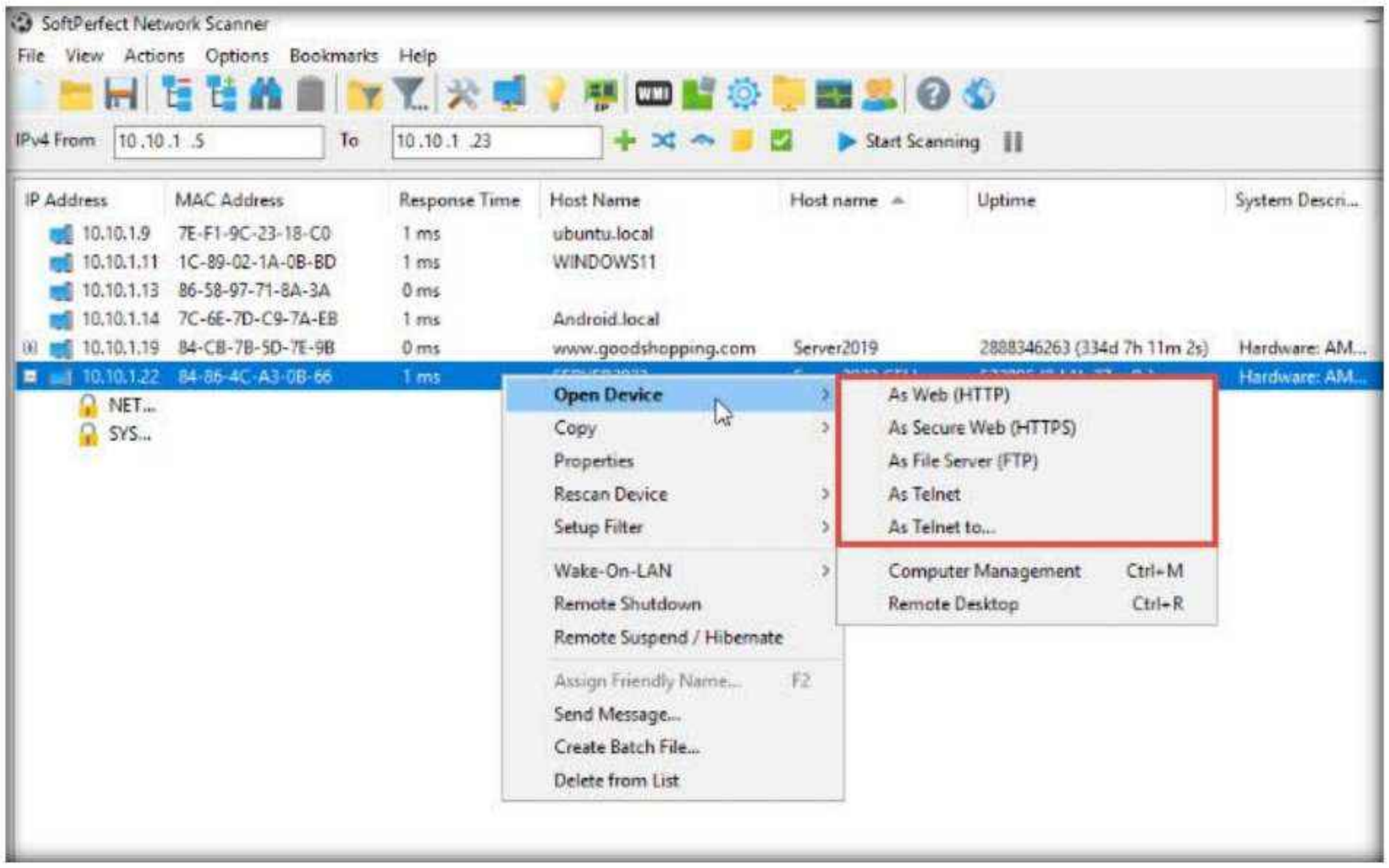
13. Close the **Properties** window.

14. To view the shared folders, note the scanned hosts that have a + node before them. Expand the node to view all the shared folders.

    Note: In this example, we are targeting the Windows Server 2022 machine (10.10.1.22).



15. Right-click the selected host, and click **Open Device**. A drop-down list appears, containing options that allow you to connect to the remote machine over HTTP, HTTPS, FTP, and Telnet.



Note: If the selected host is not secure enough, you may use these options to connect to the remote machines. You may also be able to perform activities such as sending a message and shutting down a computer remotely. These features are applicable only if the selected machine has a poor security configuration.

16. This concludes the demonstration of performing SNMP enumeration using the SoftPerfect Network Scanner.
17. You can also use other SNMP enumeration tools such as **Network Performance Monitor** (https://www.solarwinds.com), **OpUtils** (https://www.manageengine.com), **PRTG Network Monitor** (https://www.paessler.com), and **Engineer's Toolset** (https://www.solarwinds.com) to perform SNMP enumeration on the target network.
18. Close all open windows and document all the acquired information.
19. Turn off the **Windows 11**, **Windows Server 2019**, **Ubuntu** and **Android** virtual machines.

Task 3: Perform SNMP Enumeration using SnmpWalk

SnmpWalk is a command-line tool that scans numerous SNMP nodes instantly and identifies a set of variables that are available for accessing the target network. It is issued to the root node so that the information from all the sub nodes such as routers and switches can be fetched.

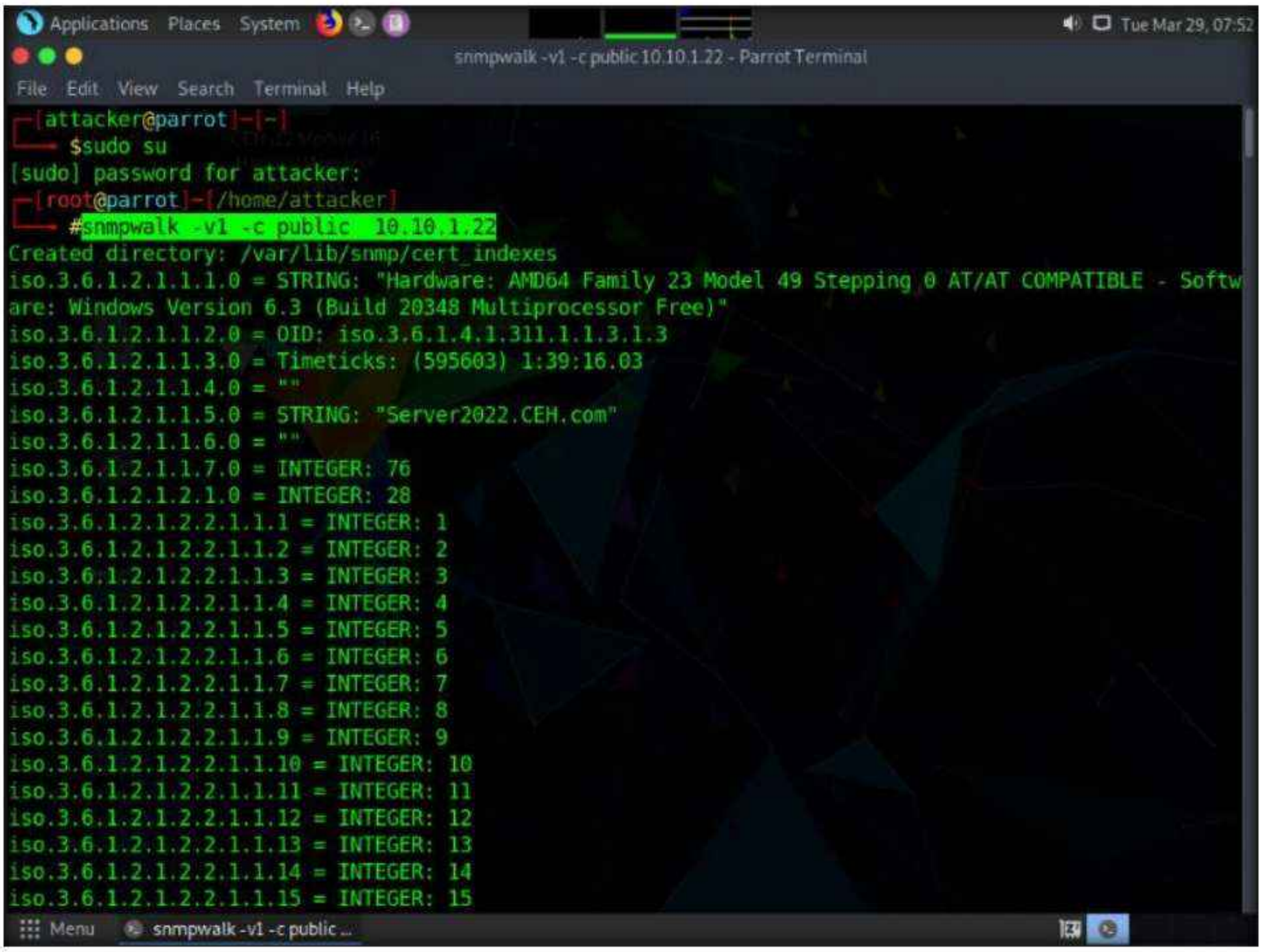
Here, we will use SnmpWalk to perform SNMP enumeration on a target system.

Note: Ensure that the **Windows Server 2022** virtual machine is running.

1. Switch to the **Parrot Security** virtual machine.
2. Click the **MATE Terminal** icon at the top of the **Desktop** to open a **Terminal** window.
3. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
4. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

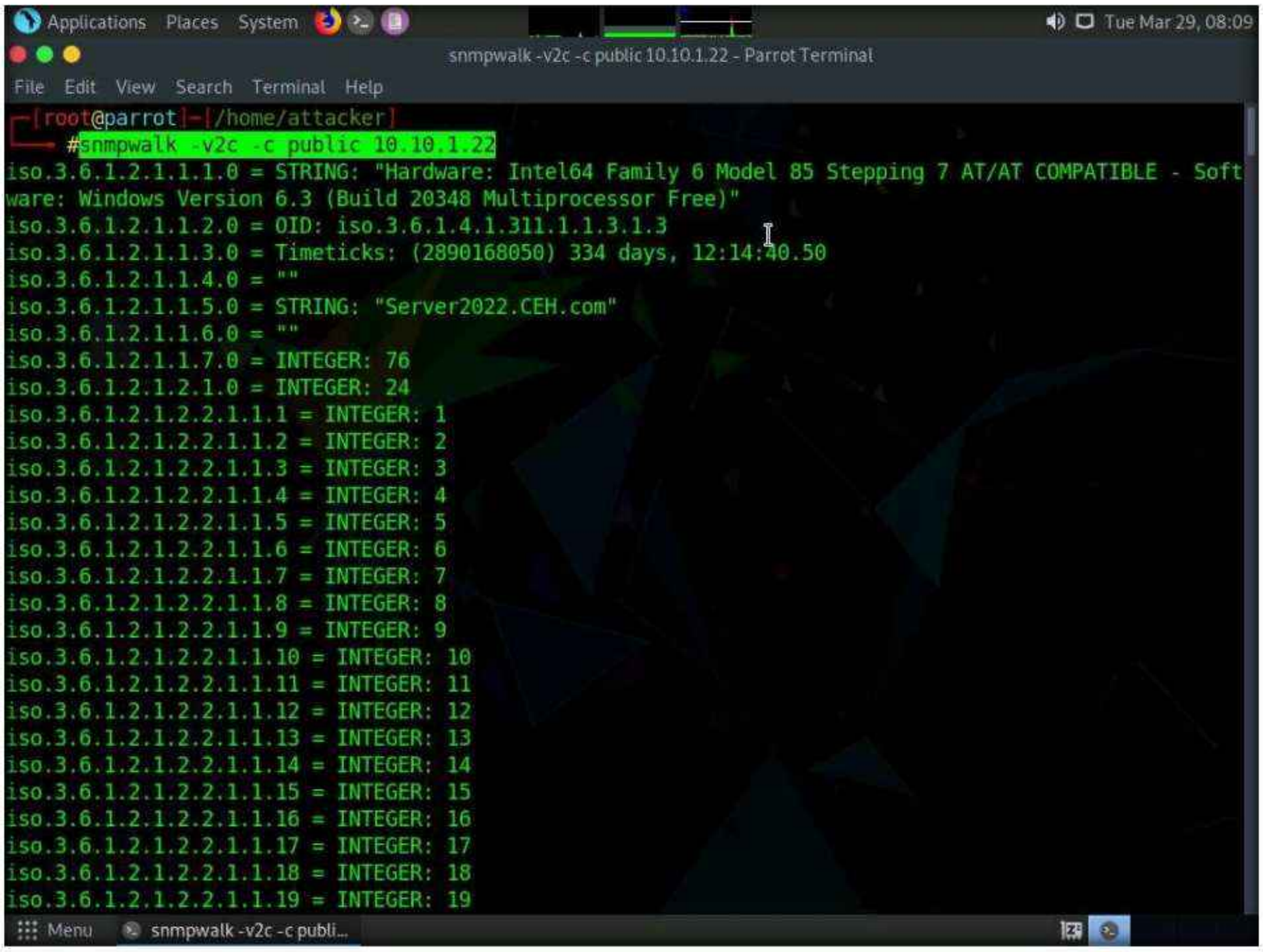
   Note: The password that you type will not be visible.
5. Type **snmpwalk -v1 -c public [target IP]** and press **Enter** (here, the target IP address is **10.10.1.22**).

   Note: **–v**: specifies the SNMP version number (1 or 2c or 3) and **–c**: sets a community string.
6. The result displays all the OIDs, variables and other associated information.



7. Type **snmpwalk -v2c -c public [Target IP Address]** and press **Enter** to perform SNMPv2 enumeration on the target machine.

   Note: **–v**: specifies the SNMP version (here, 2c is selected) and **–c**: sets a community string.



8. The result displays data transmitted from the SNMP agent to the SNMP server, including information on server, user credentials, and other parameters.
9. This concludes the demonstration of performing SNMP enumeration using the SnmpWalk.
10. Close all open windows and document all the acquired information.

Task 4: Perform SNMP Enumeration using Nmap

The Nmap snmp script is used against an SNMP remote server to retrieve information related to the hosted SNMP services.

Here, we will use various Nmap scripts to perform SNMP enumeration on the target system.

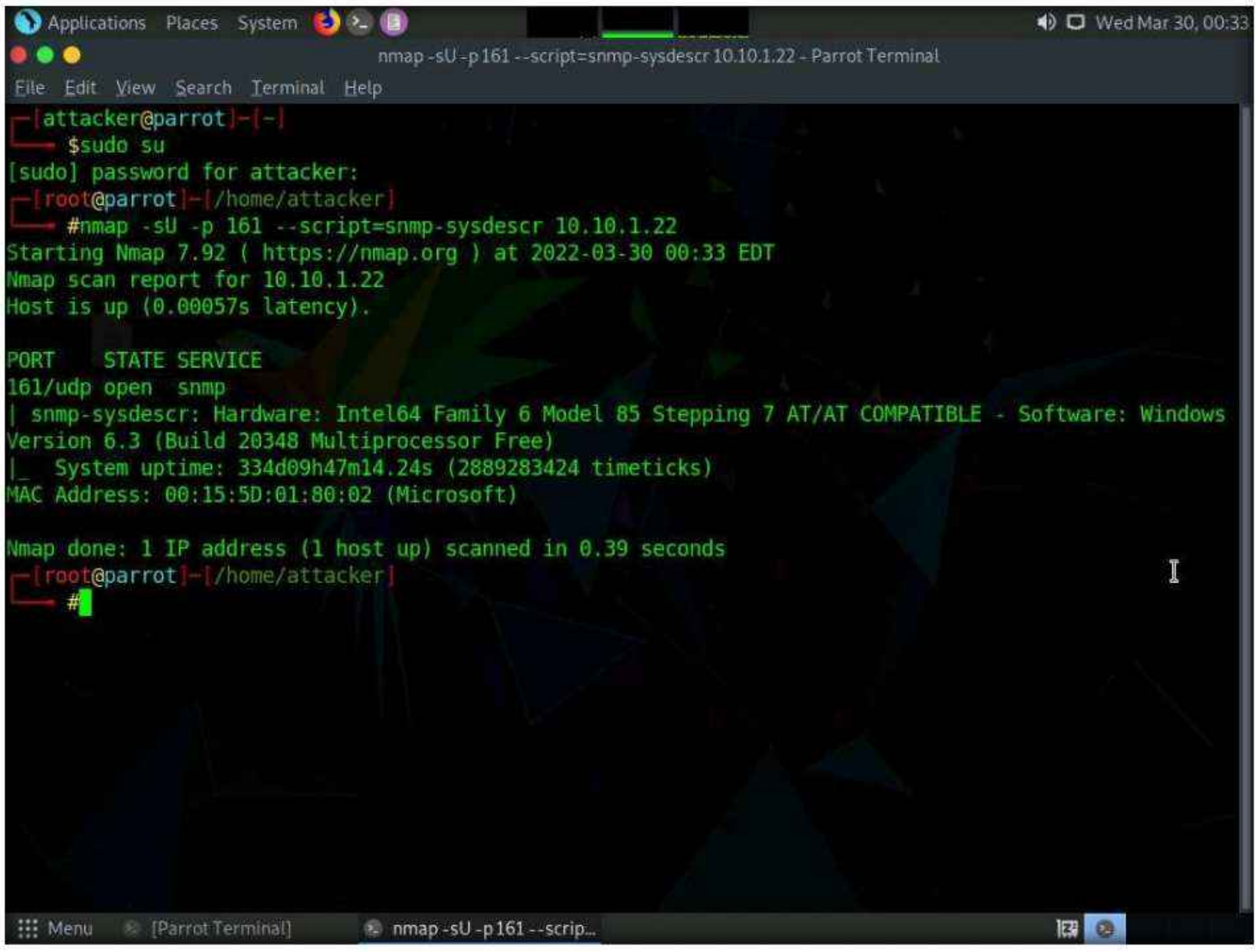
Note: Here, we will perform SNMP enumeration on a target machine **Windows Server 2022** (10.10.1.22).

1. In the **Parrot Security** machine, click the **MATE Terminal** icon at the top-left corner of **Desktop** to launch a **Terminal** window.
2. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
3. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.
4. In the terminal, type **nmap -sU -p 161 --script=snmp-sysdescr [target IP Address]** and press **Enter** (here, the target IP address is **10.10.1.22**).

   Note: **-sU**: specifies a UDP scan, **-p**: specifies the port to be scanned, and **-–script**: is an argument used to execute a given script (here, **snmp-sysdescr**).
5. The result appears displaying information regarding SNMP server type and operating system details, as shown in the screenshot below.

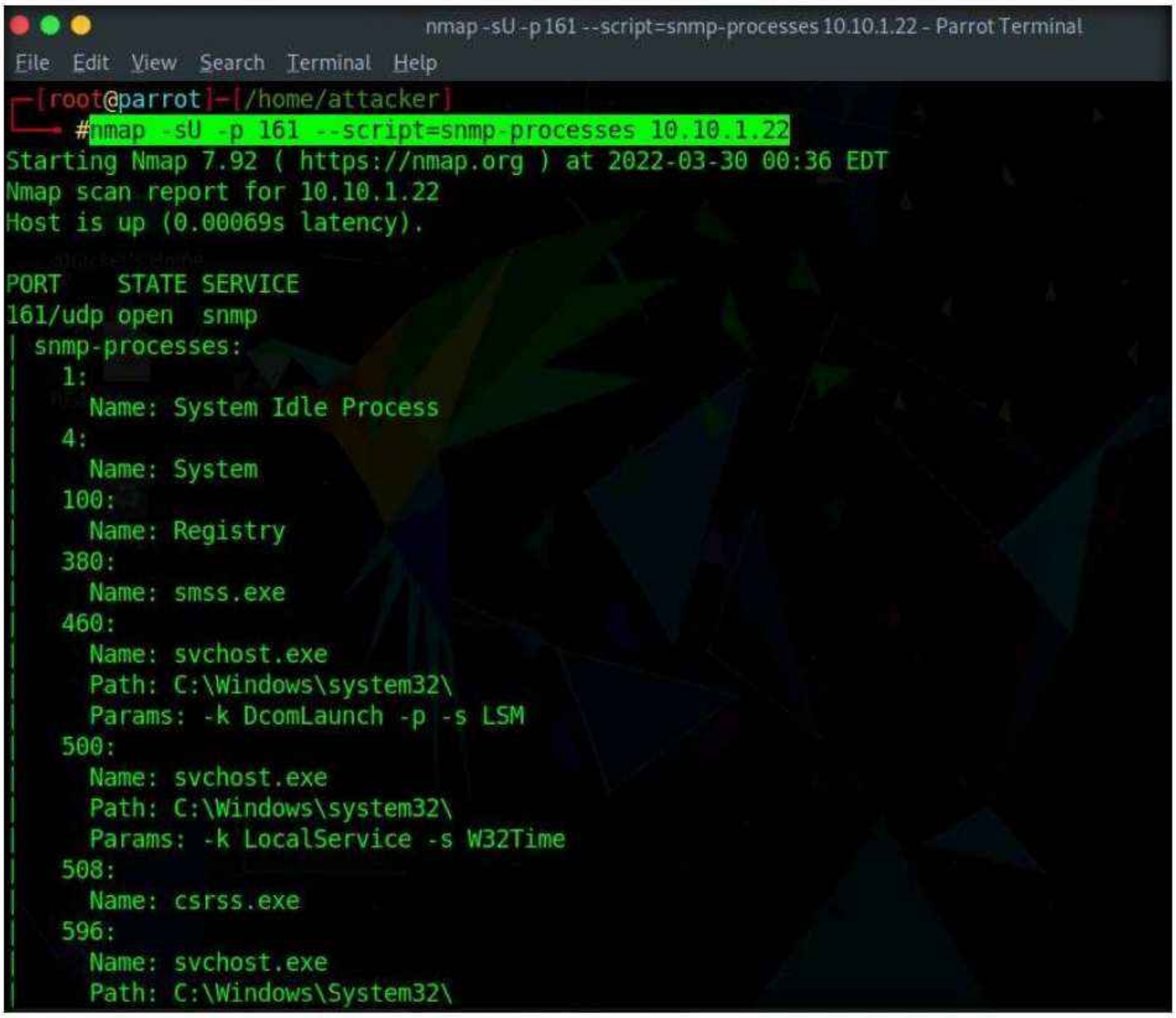
   Note: The MAC addresses might differ when you perform this task.



6. Type **nmap -sU -p 161 --script=snmp-processes [target IP Address]** and press **Enter** (here, the target IP address is **10.10.1.22**).

   Note: **-sU**: specifies UDP scan, **-p**: specifies the port to be scanned, and **-–script**: is an argument used to execute a given script (here, **snmp-processes**).

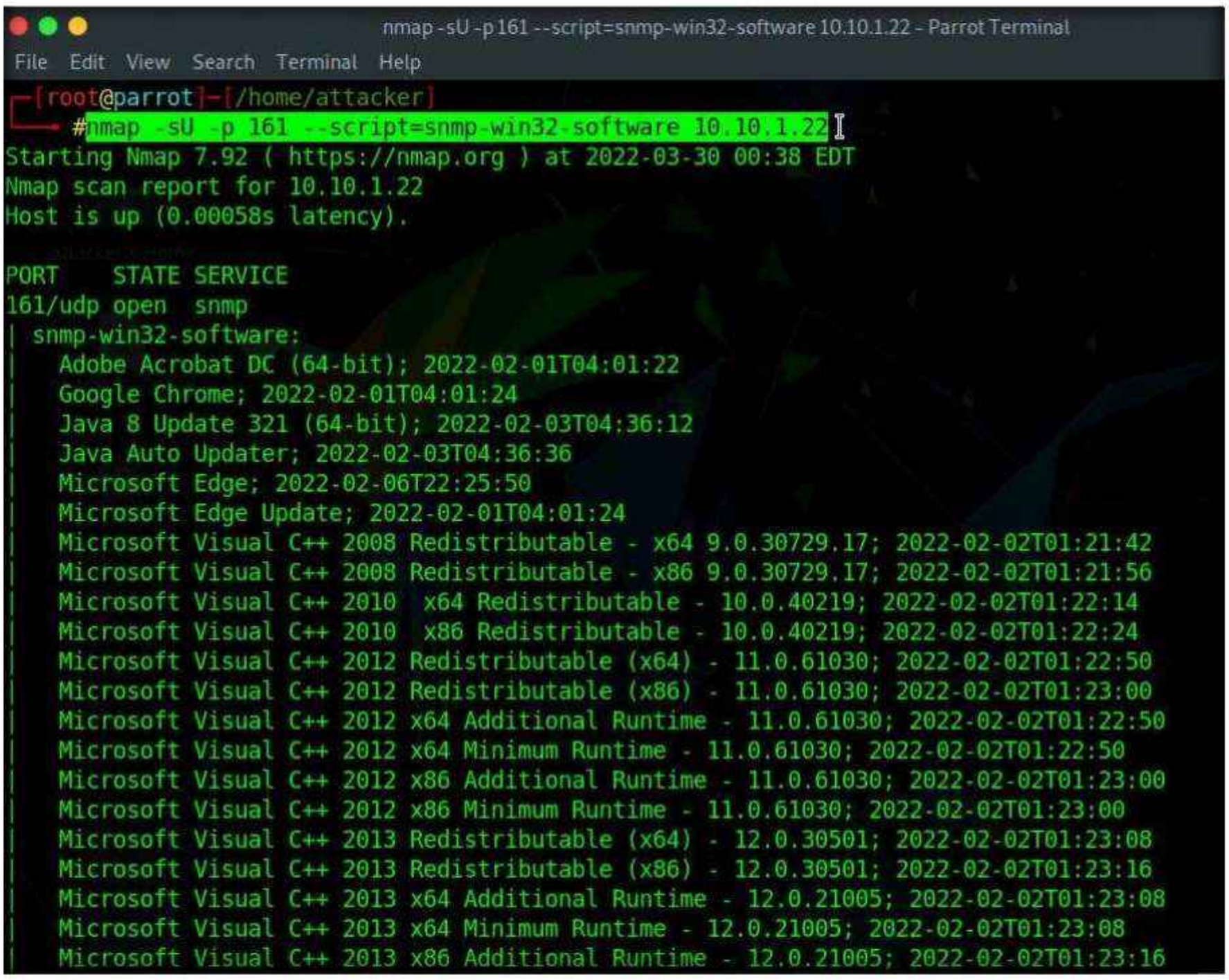
7. The result appears displaying a list of all the running SNMP processes along with the associated ports on the target machine (here, **Windows Server 2022**), as shown in the screenshot below.



8. Type **nmap -sU -p 161 --script=snmp-win32-software [target IP Address]** and press **Enter** (here, the target IP address is **10.10.1.22**).

   Note: **-sU**: specifies UDP scan, **-p**: specifies the port to be scanned, and **-–script**: argument used to execute a given script (here, the script is **snmp-win32-software**).

9. The result appears displaying a list of all the applications running on the target machine (here, **Windows Server 2022**), as shown in the screenshot.

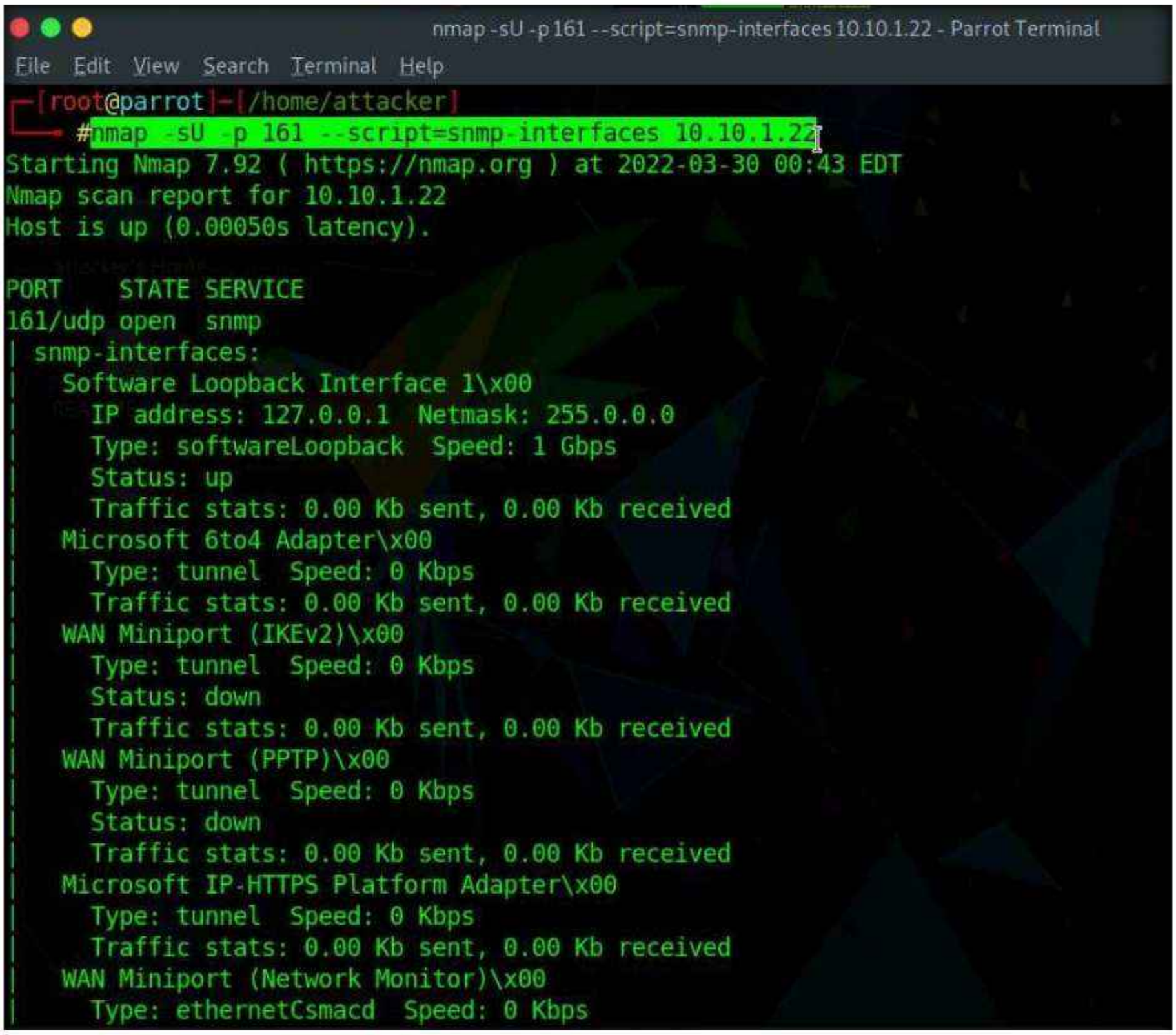


10. Type **nmap -sU -p 161 --script=snmp-interfaces [target IP Address]** and press **Enter** (here the target IP address is **10.10.1.22**).

    Note: **-sU** specifies a UDP scan, **-p** specifies the port to be scanned, and **-–script** is an argument allows us to run a given script (here, **snmp-interfaces**).

11. The result appears displaying information about the Operating system, network interfaces, and applications that are installed on the target machine (here, **Windows Server 2022**), as shown in the screenshot below.

    Note: The list of interfaces might differ when you perform the task.



12. This concludes the demonstration of performing SNMP enumeration using Nmap.
13. Close all open windows and document all the acquired information.
14. Turn off the **Parrot Security** and **Windows Server 2022** virtual machines.

Lab Analysis

Analyze and document the results of this lab exercise.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Internet Connection Required	
☐ Yes	☑ No
Platform Supported	
☑ Classroom	☑ CyberQ

Lab 3

Perform LDAP Enumeration

This method of enumeration uses LDAP to generate a list of distributed directory services on the target system.

Lab Scenario

As a professional ethical hacker or penetration tester, the next step after SNMP enumeration is to perform LDAP enumeration to access directory listings within Active Directory or other directory services. Directory services provide hierarchically and logically structured information about the components of a network, from lists of printers to corporate email directories. In this sense, they are similar to a company's org chart.

LDAP enumeration allows you to gather information about usernames, addresses, departmental details, server names, etc.

Lab Objectives

- Perform LDAP enumeration using Active Directory Explorer (AD Explorer)
- Perform LDAP enumeration using Python and Nmap
- Perform LDAP enumeration using ldapsearch

Lab Environment

To carry out this lab, you need:

- Windows 11 virtual machine
- Windows Server 2022 virtual machine
- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 25 Minutes

Overview of LDAP Enumeration

LDAP (Lightweight Directory Access Protocol) is an Internet protocol for accessing distributed directory services over a network. LDAP uses DNS (Domain Name System) for quick lookups and fast resolution of queries. A client starts an LDAP session by connecting to a DSA (Directory System Agent), typically on TCP port 389, and sends an operation request to the DSA, which then responds. BER (Basic Encoding Rules) is used to transmit information between the client and the server. One can anonymously query the LDAP service for sensitive information such as usernames, addresses, departmental details, and server names.

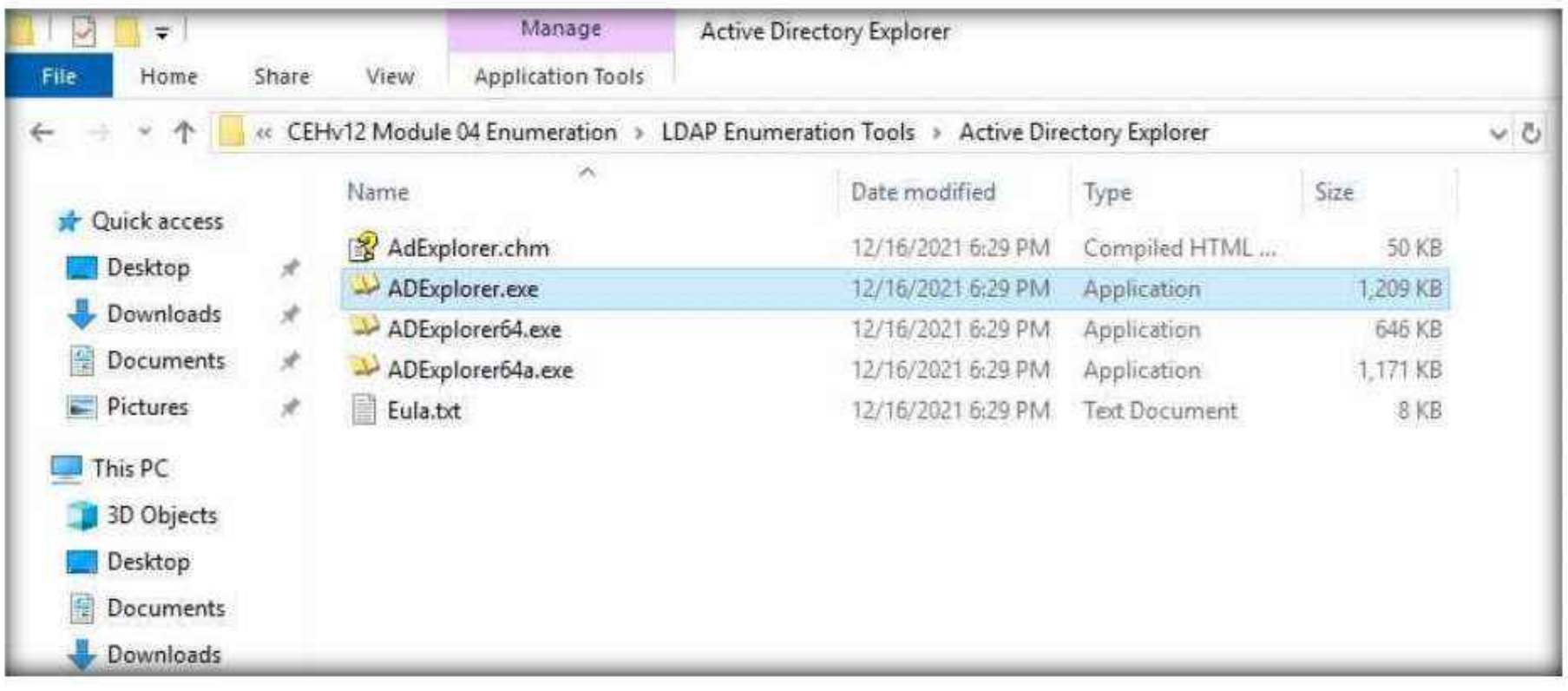
Lab Tasks

Task 1: Perform LDAP Enumeration using Active Directory Explorer (AD Explorer)

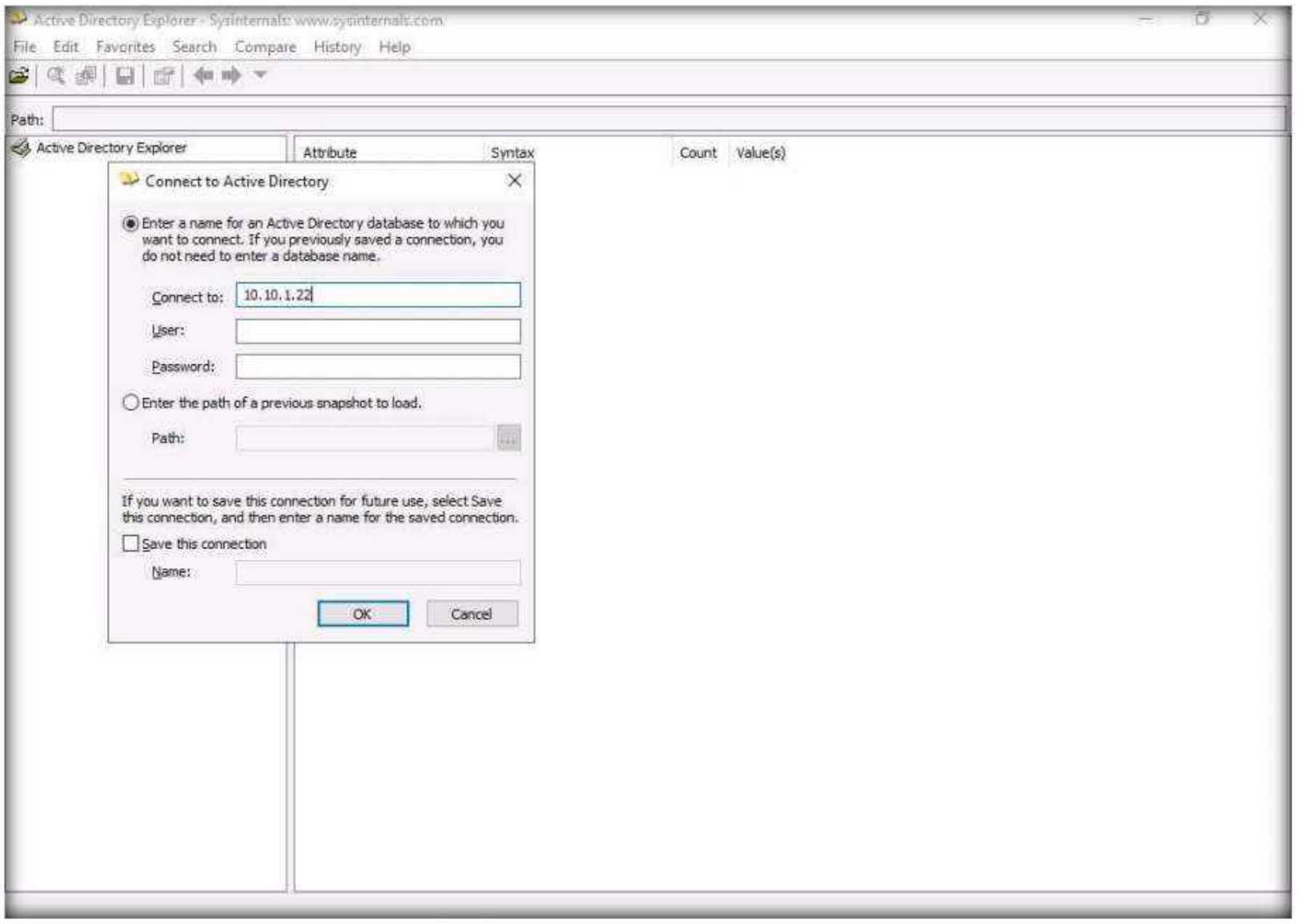
Active Directory Explorer (AD Explorer) is an advanced Active Directory (AD) viewer and editor. It can be used to navigate an AD database easily, define favorite locations, view object properties and attributes without having to open dialog boxes, edit permissions, view an object's schema, and execute sophisticated searches that can be saved and re-executed.

Here, we will use the AD Explorer to perform LDAP enumeration on an AD domain and modify the domain user accounts.

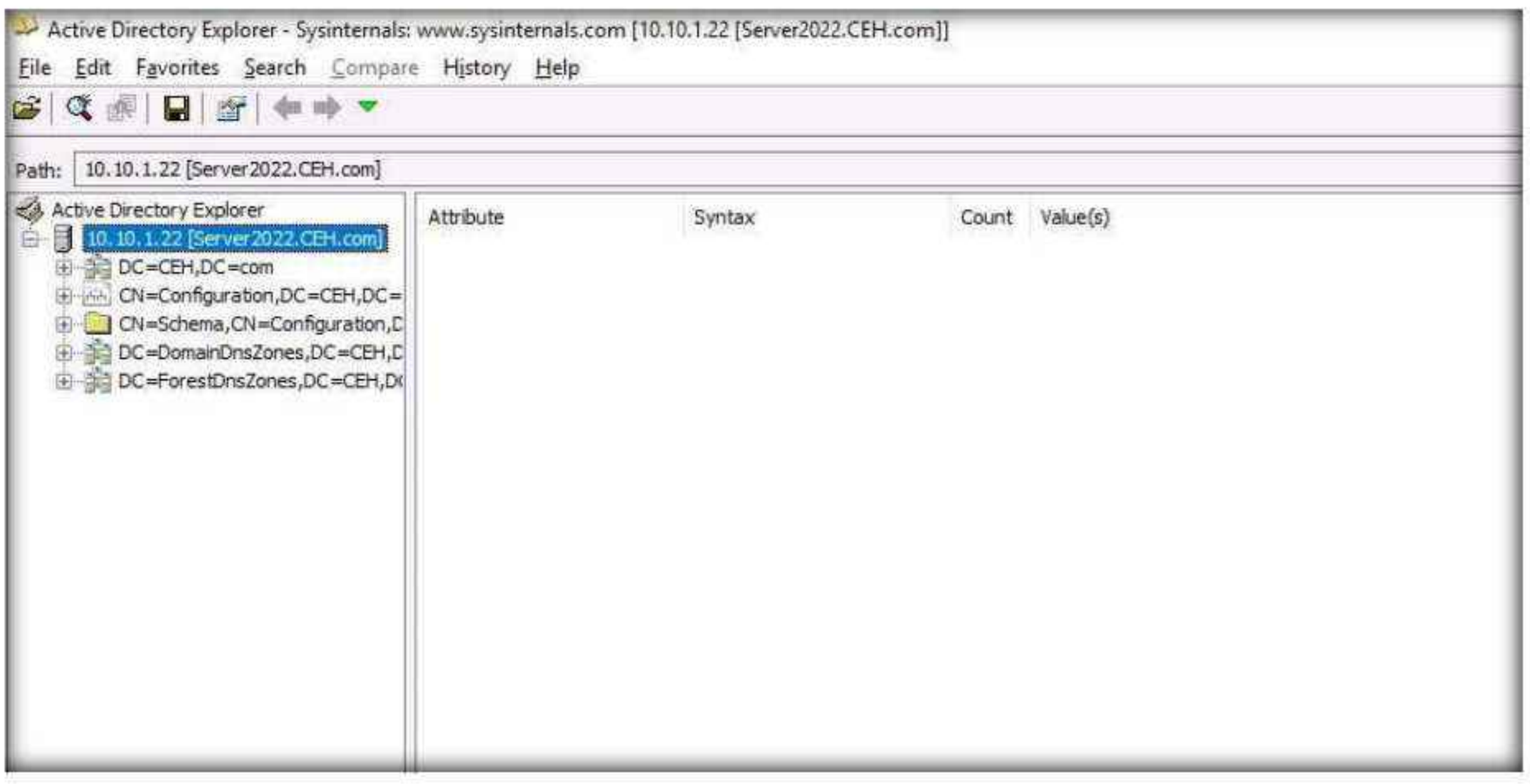
1. Turn on the **Windows 11**, **Windows Server 2022** and **Windows Server 2019** virtual machines.
2. Switch to the **Windows Server 2019** virtual machine. Click **Ctrl+Alt+Del** to activate the machine. By default, **Administrator** user profile is selected, type **Pa$$w0rd** in the **Password** field and press **Enter** to login.
3. Navigate to **Z:\CEHv12 Module 04 Enumeration\LDAP Enumeration Tools\Active Directory Explorer** and double-click **ADExplorer.exe**.



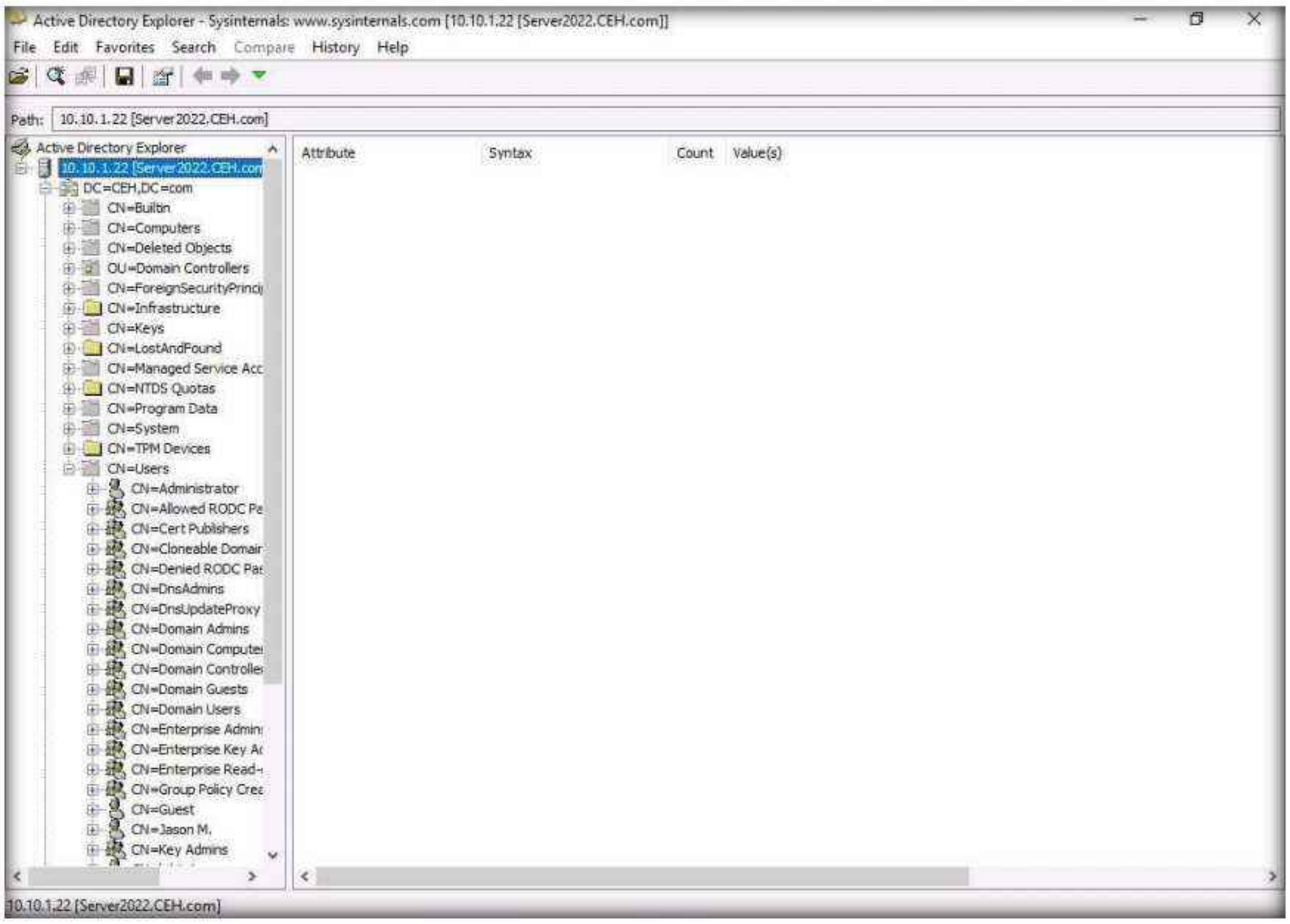
4. The **Active Directory Explorer License Agreement** window appears; click **Agree**.
5. The **Connect to Active Directory** pop-up appears; type the IP address of the target in the **Connect to** field (in this example, we are targeting the **Windows Server 2022** machine: **10.10.1.22**) and click **OK**.



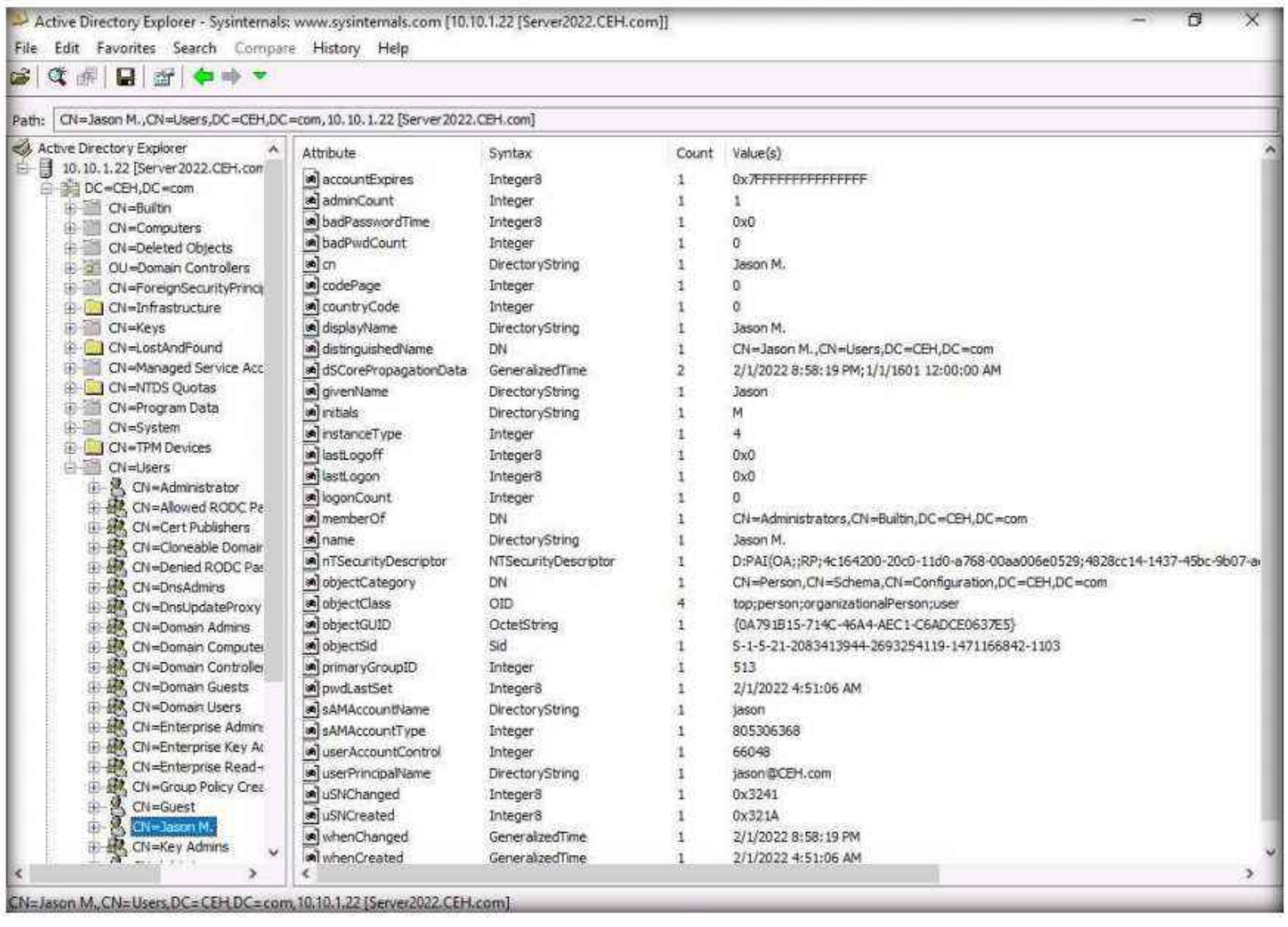
6. The **Active Directory Explorer** displays the active directory structure in the left pane, as shown in the screenshot.



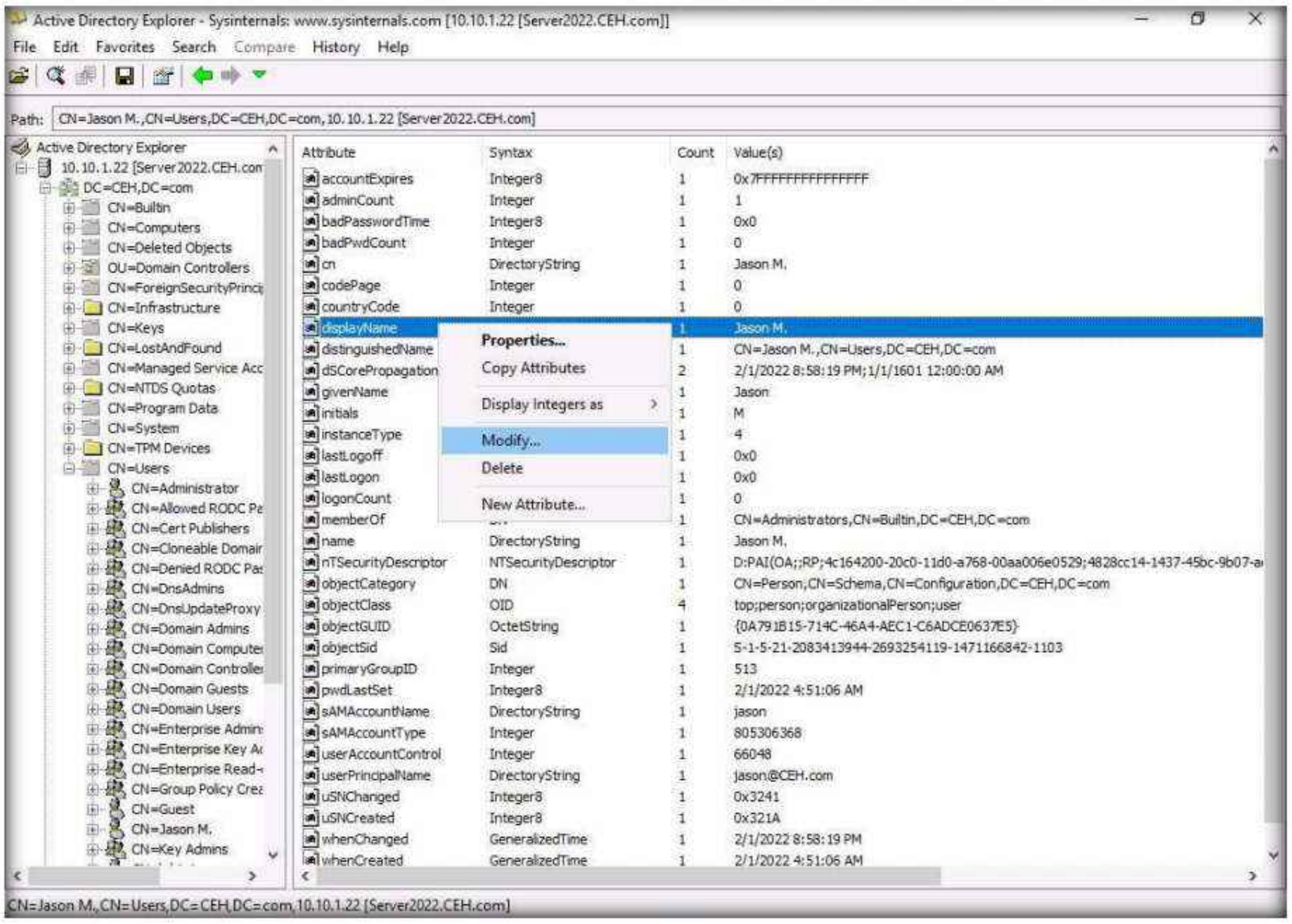
7. Now, expand **DC=CEH**, **DC=com**, and **CN=Users** by clicking "**+**" to explore domain user details.



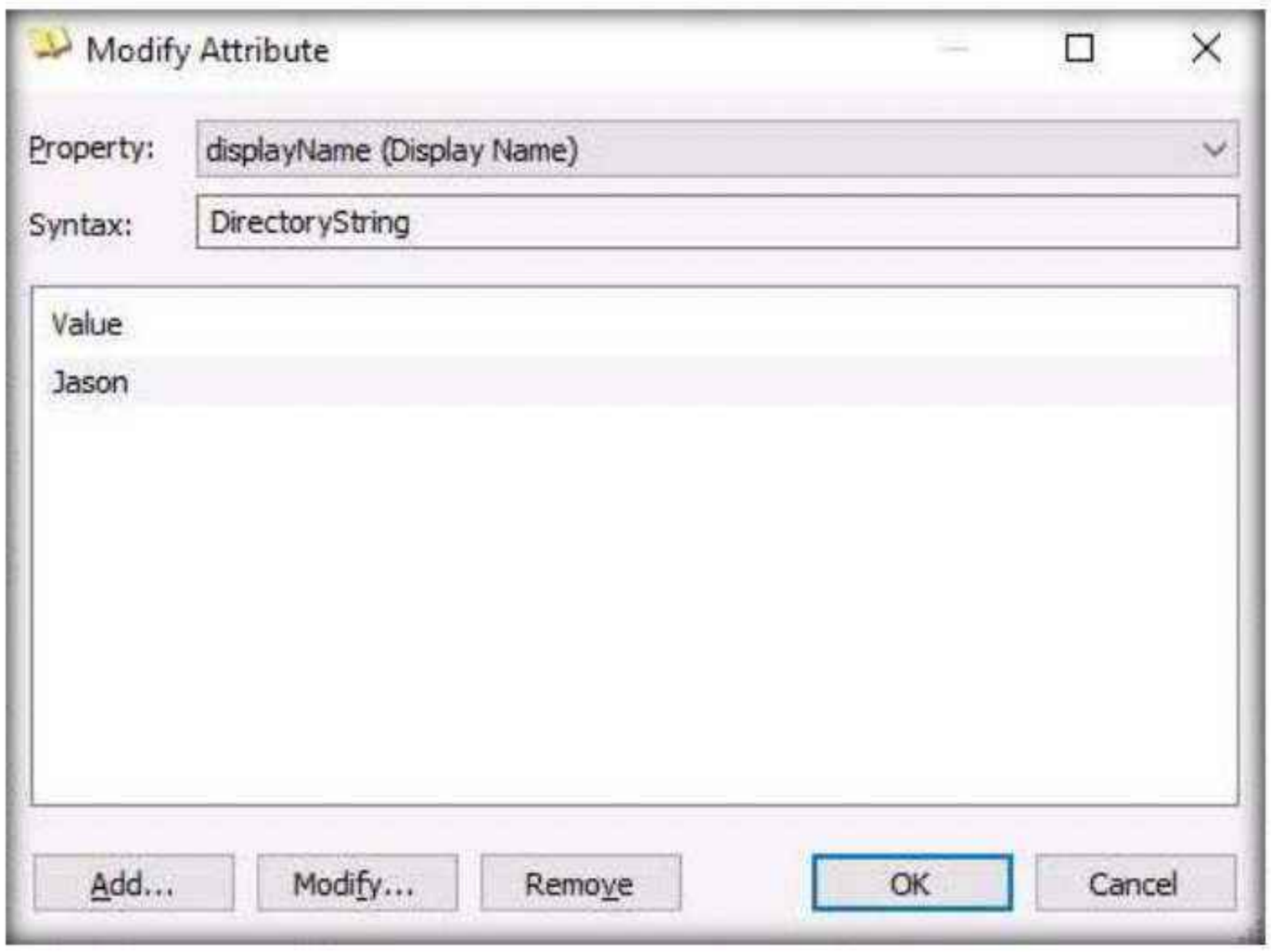
8. Click any **username** (in the left pane) to display its properties in the right pane.



9. Right-click any attribute in the right pane (in this case, **displayName**) and click **Modify…** from the context menu to modify the user's profile.



10. The **Modify Attribute** window appears. First, select the username under the **Value** section, and then click the **Modify…** button. The **Edit Value** pop-up appears. Rename the username in the **Value data** field and click **OK** to save the changes.



11. You can read and modify other user profile attributes in the same way.
12. This concludes the demonstration of performing LDAP enumeration using AD Explorer.
13. You can also use other LDAP enumeration tools such as **Softerra LDAP Administrator** (https://www.ldapadministrator.com), **LDAP Admin Tool** (https://www.ldapsoft.com), **LDAP Account Manager** (https://www.ldap-account-manager.org), and **LDAP Search** (https://securityxploded.com) to perform LDAP enumeration on the target.
14. Close all open windows and document all the acquired information.
15. Turn off the **Windows 11** and **Windows Server 2019** virtual machines.

Task 2: Perform LDAP Enumeration using Python and Nmap

LDAP enumeration can be performed using both manual and automated methods. Using various Python commands LDAP enumeration is performed on the target host to obtain information such as domains, naming context, directory objects, etc. Using NSE script can be used to perform queries to brute force LDAP authentication using the built-in username and password lists.

Here, we will use Nmap and python commands to extract details on the LDAP server and connection.

Note: Ensure that the **Windows Server 2022** virtual machine is running.

1. Turn on the **Parrot Security** virtual machine.
2. In the login page, the **attacker** username will be selected by default. Enter password as **toor** in the **Password** field and press **Enter** to log in to the machine.

   Note: If a **Parrot Updater** pop-up appears at the top-right corner of **Desktop**, ignore and close it.

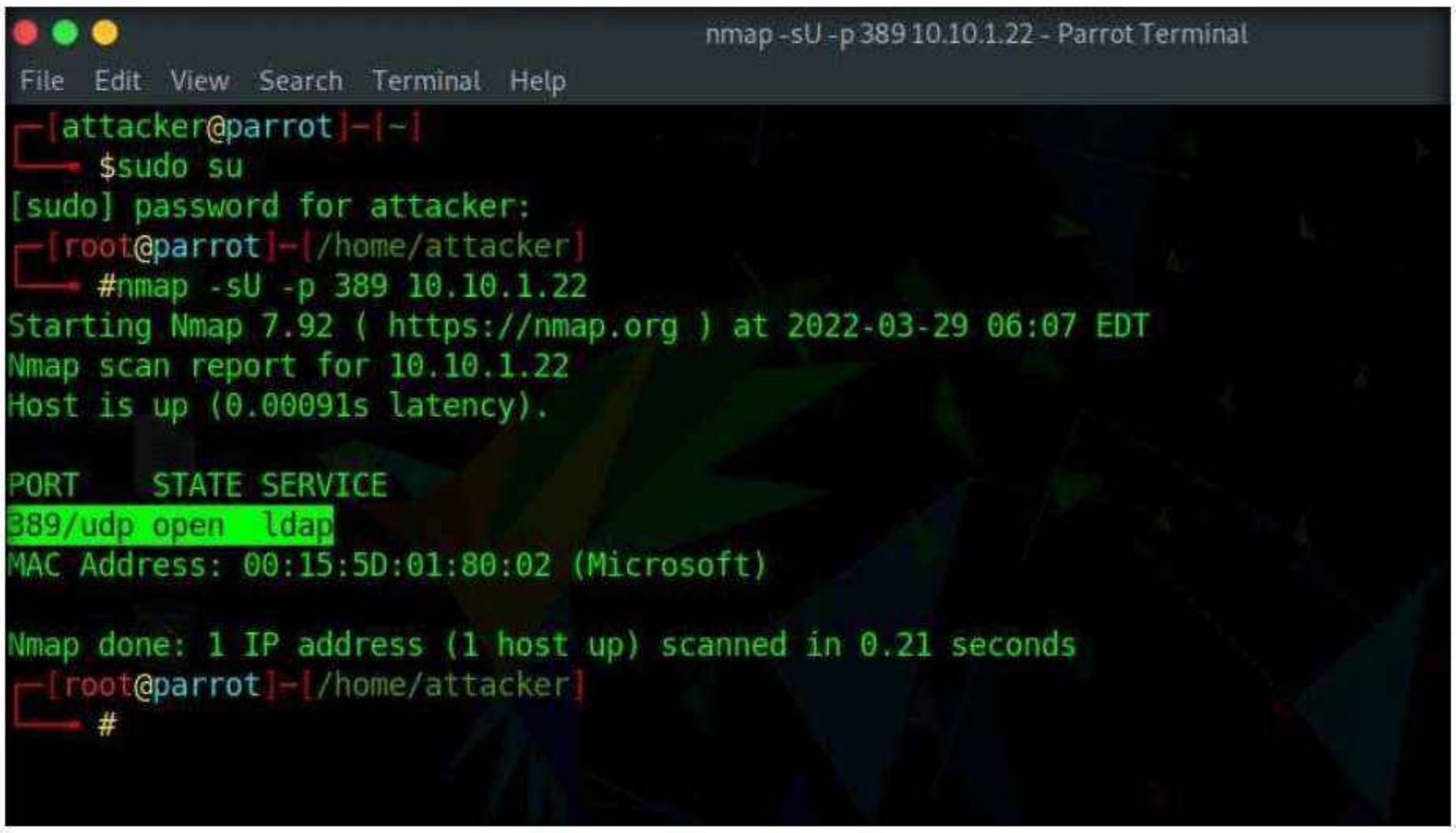
   Note: If a **Question** pop-up window appears asking you to update the machine, click **No** to close the window.
3. Click the **MATE Terminal** icon at the top-left corner of the **Desktop** to open a **Terminal** window.
4. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
5. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.
6. In the **Parrot Terminal** window, type **nmap -sU -p 389 [Target IP address]** (here, the target IP address is **10.10.1.22**) and press **Enter**.

   Note: **-sU**: performs a UDP scan and **-p**: specifies the port to be scanned.

7. The results appear, displaying that the port 389 is **open** and being used by LDAP, as shown in the screenshot below.

   Note: The MAC addresses might differ when you perform this task.

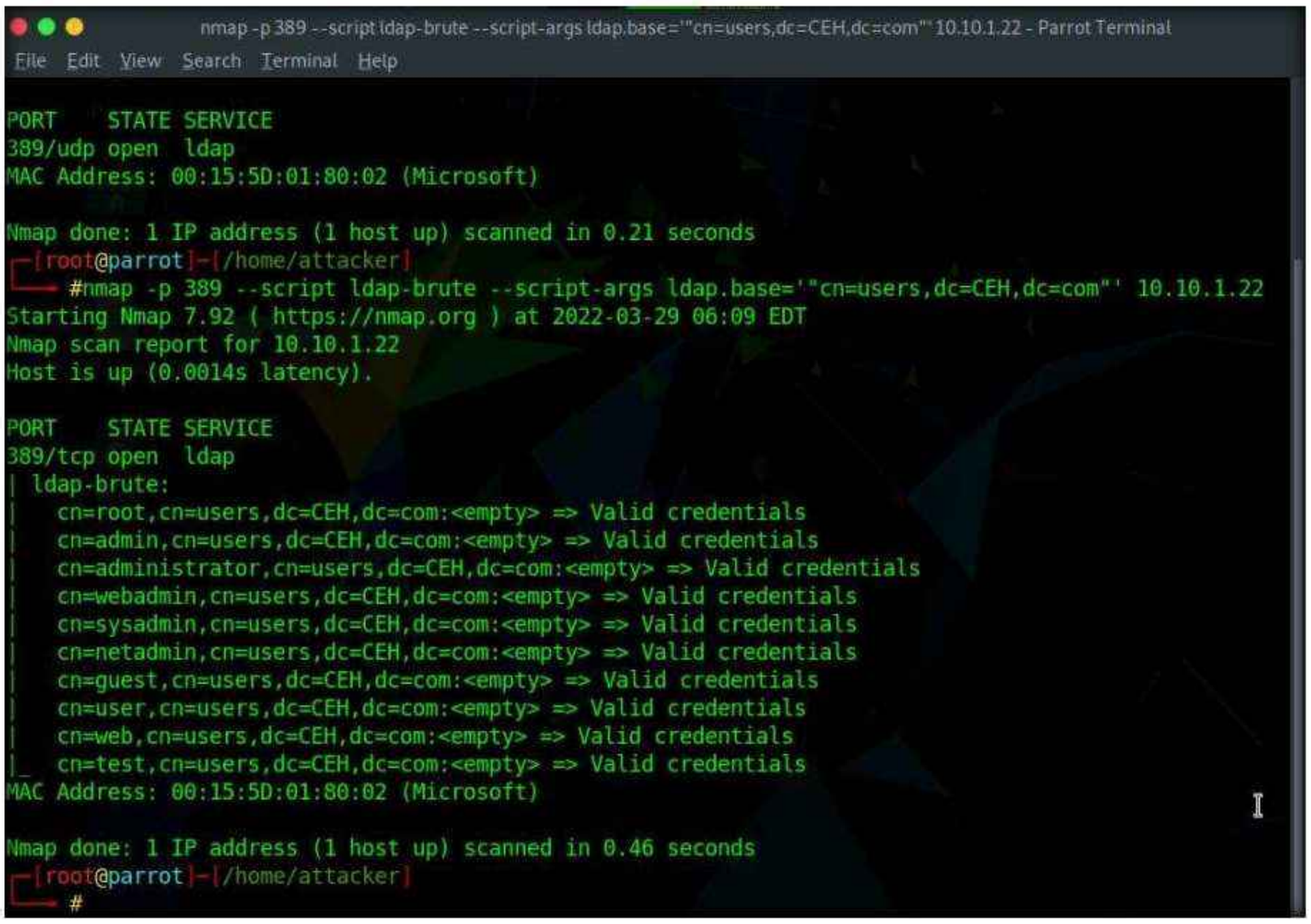


8. Now, we will use NSE script to perform username enumeration on the target machine **Windows Server 2022** (10.10.1.22).

9. Type **nmap -p 389 --script ldap-brute --script-args ldap.base='"cn=users,dc=CEH,dc=com"' [Target IP Address]** (here, the target IP address is **10.10.1.22**) and press **Enter**.

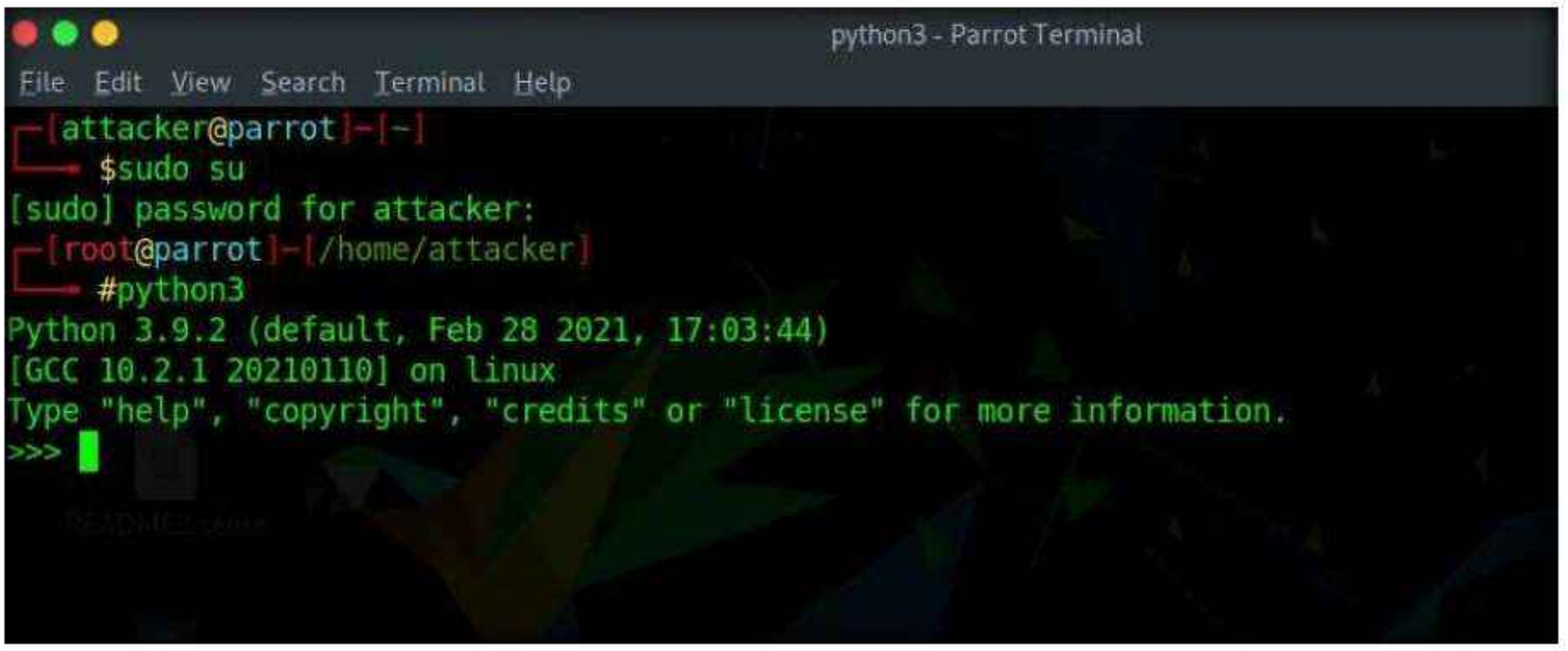
   Note: **-p**: specifies the port to be scanned, **ldap-brute**: to perform brute-force LDAP authentication. **ldap.base**: if set, the script will use it as a base for the password guessing attempts.

10. Nmap attempts to brute-force LDAP authentication and displays the usernames that are found, as shown in the screenshot below.

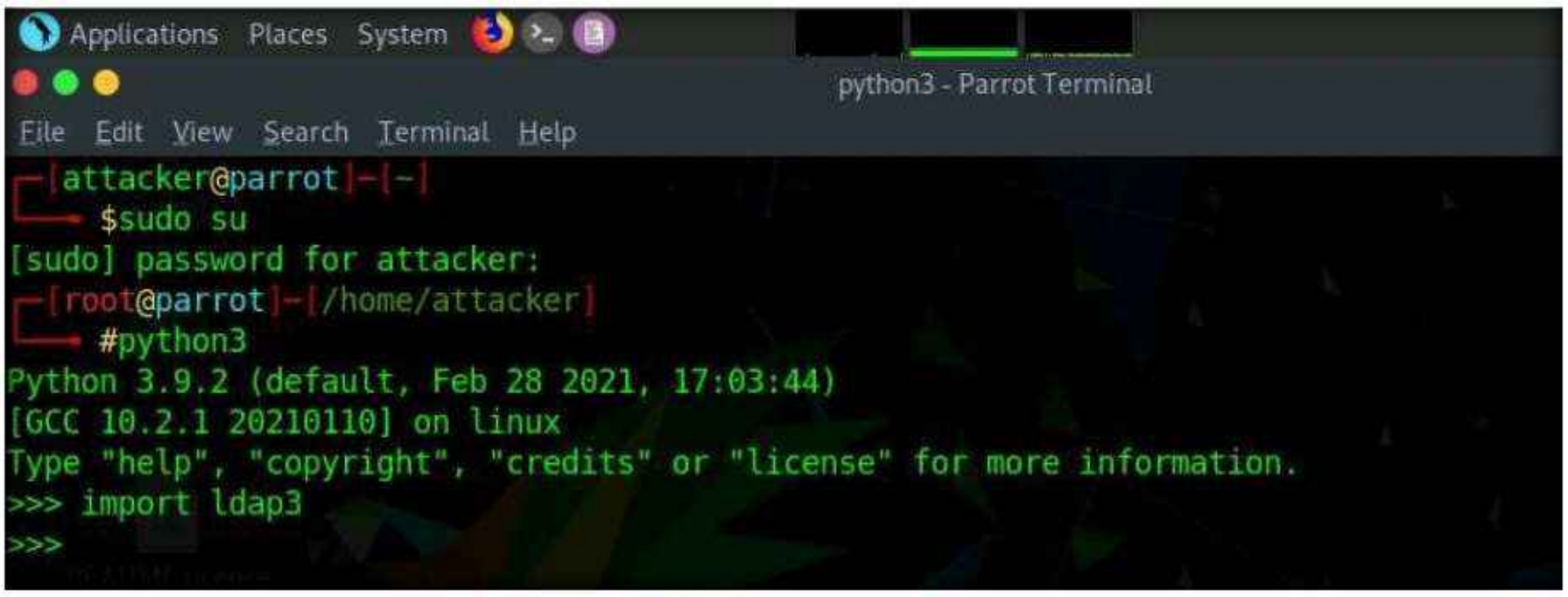


11. Close the terminal window. Now, we will perform manual LDAP Enumeration using Python.
12. Click the **MATE Terminal** icon at the top-left corner of the **Desktop** to open a **Terminal** window.
13. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
14. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

    Note: The password that you type will not be visible.
15. Type **python3** and press **Enter** to open a python3 shell.

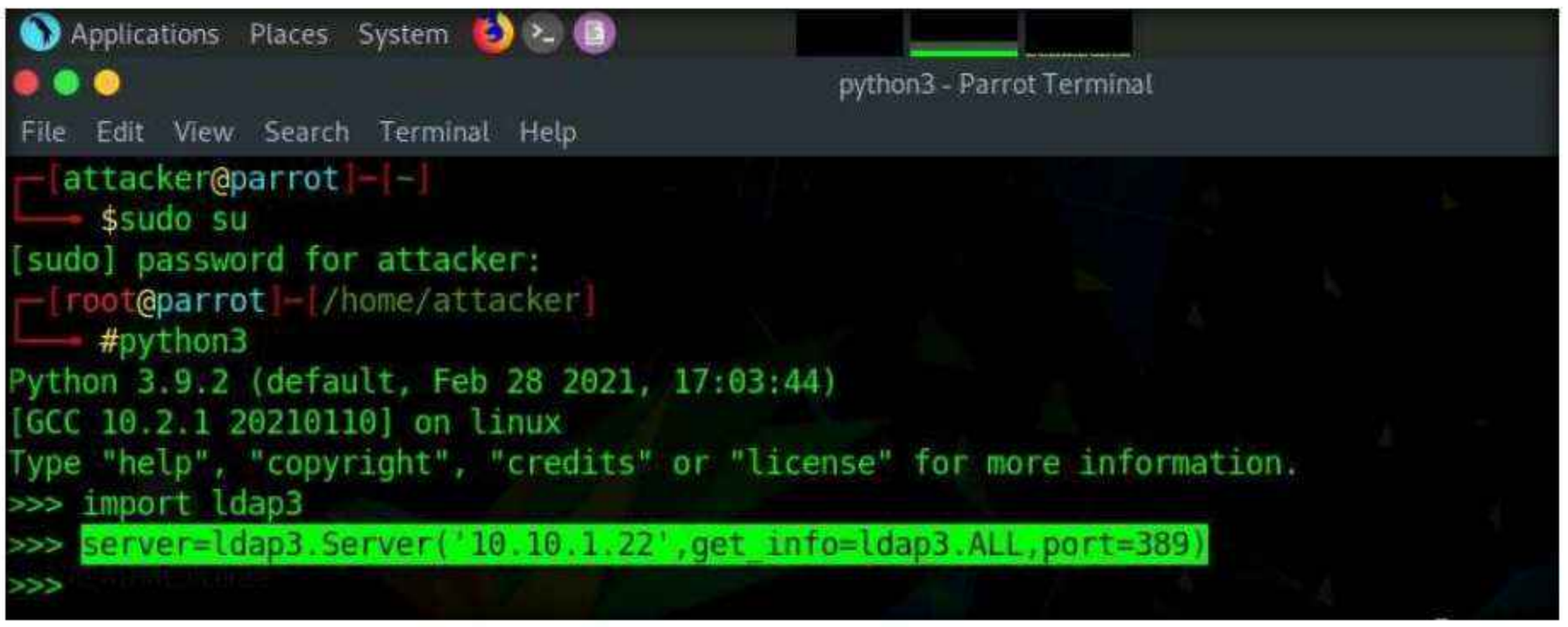


16. Type **import ldap3** and press **Enter** to import LDAP.

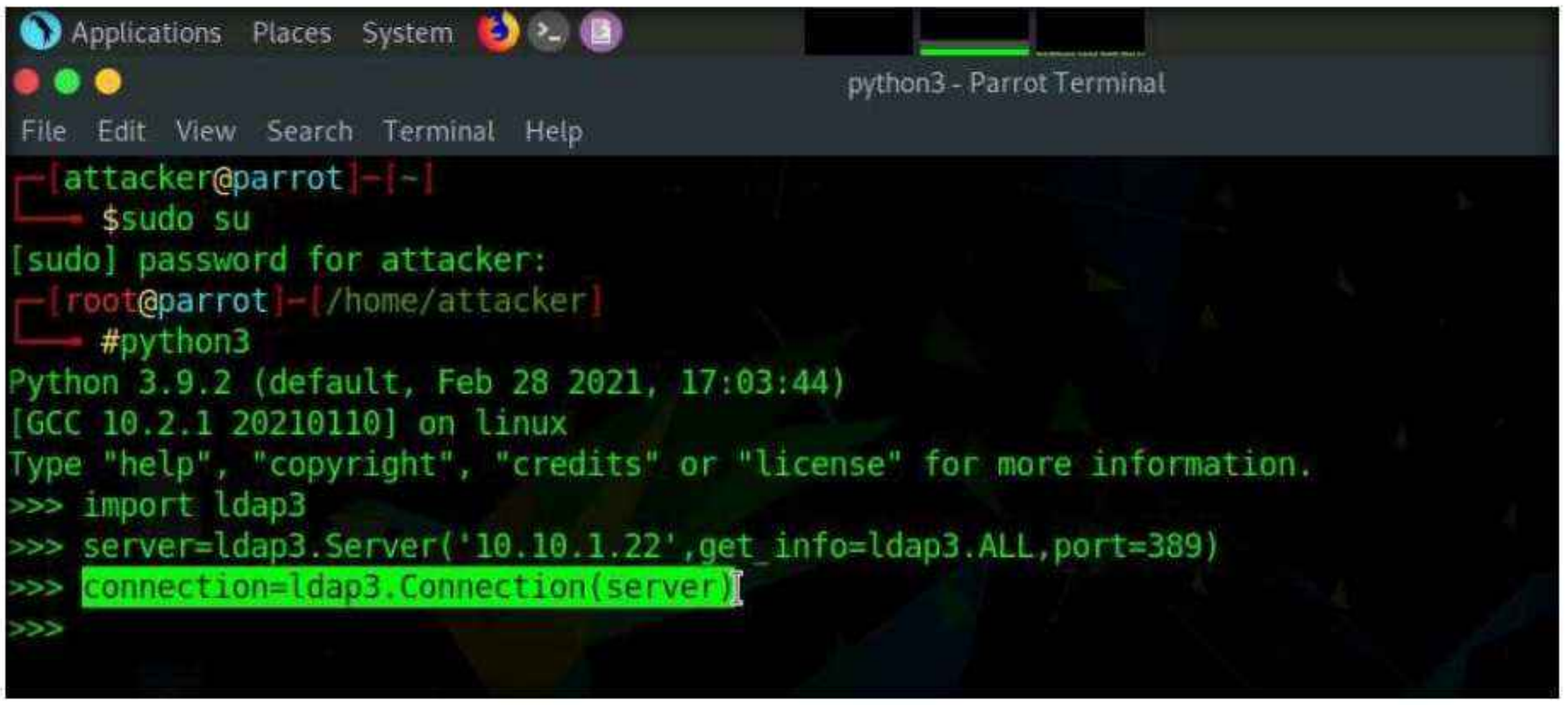


17. Now, we will connect to the target LDAP server without credentials using python.

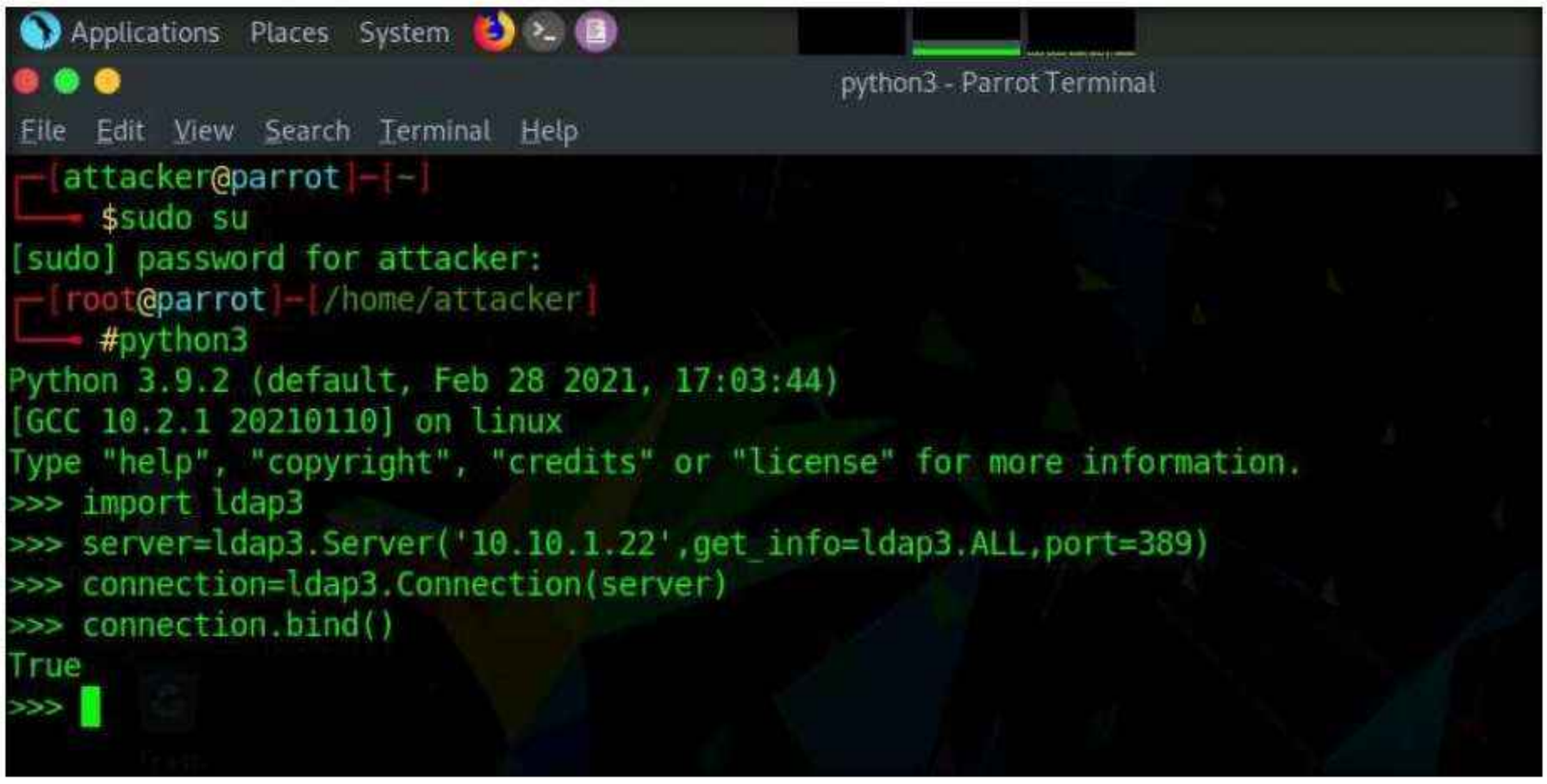
18. Type **server=ldap3.Server('[Target IP Address]', get_info=ldap3.ALL,port=[Target Port])** and press **Enter** to provide the target IP address and port number (here, the target IP address is **10.10.1.22**, and the port number is **389**).



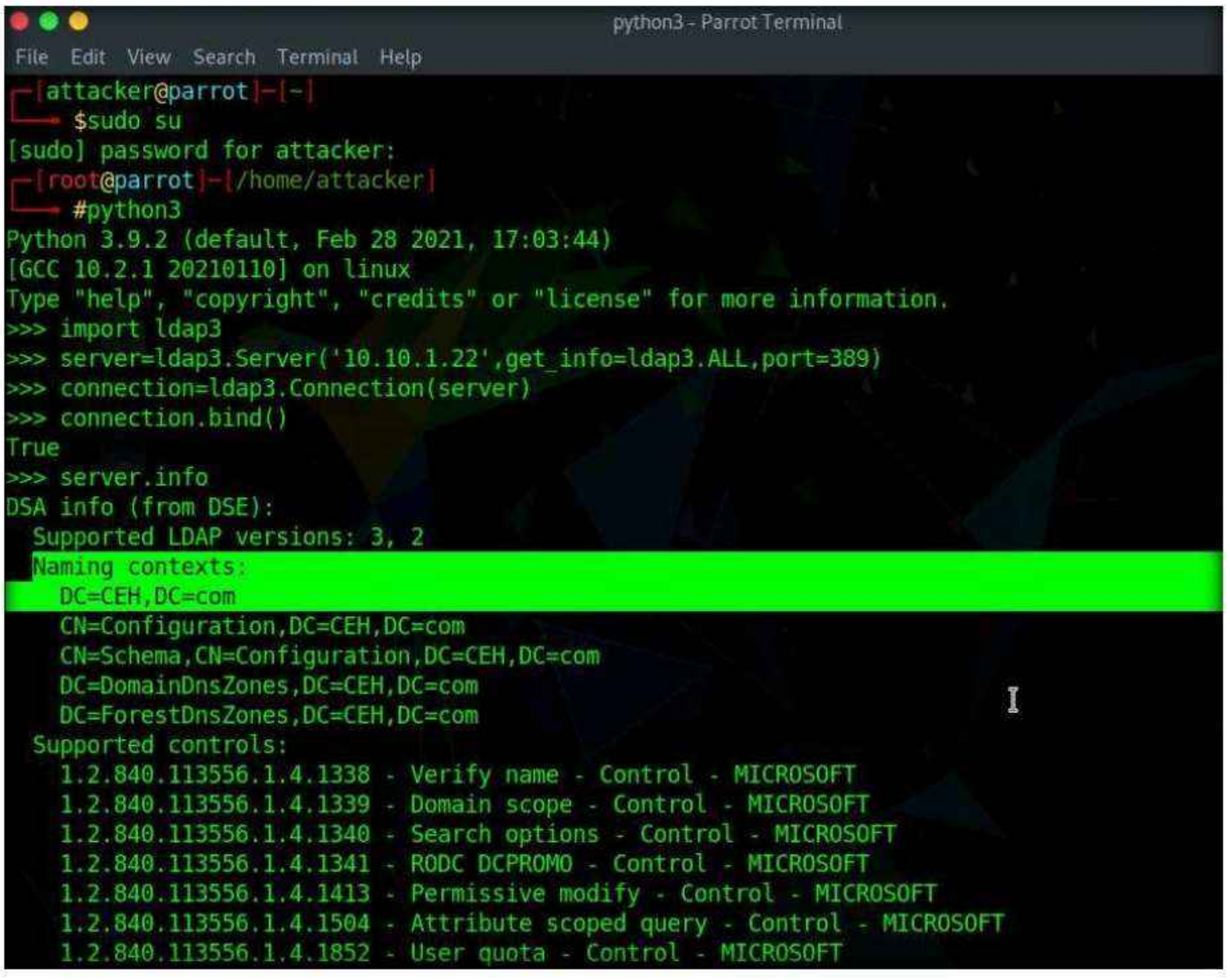
19. In the python3 shell, type **connection=ldap3.Connection(server)** and press **Enter**.



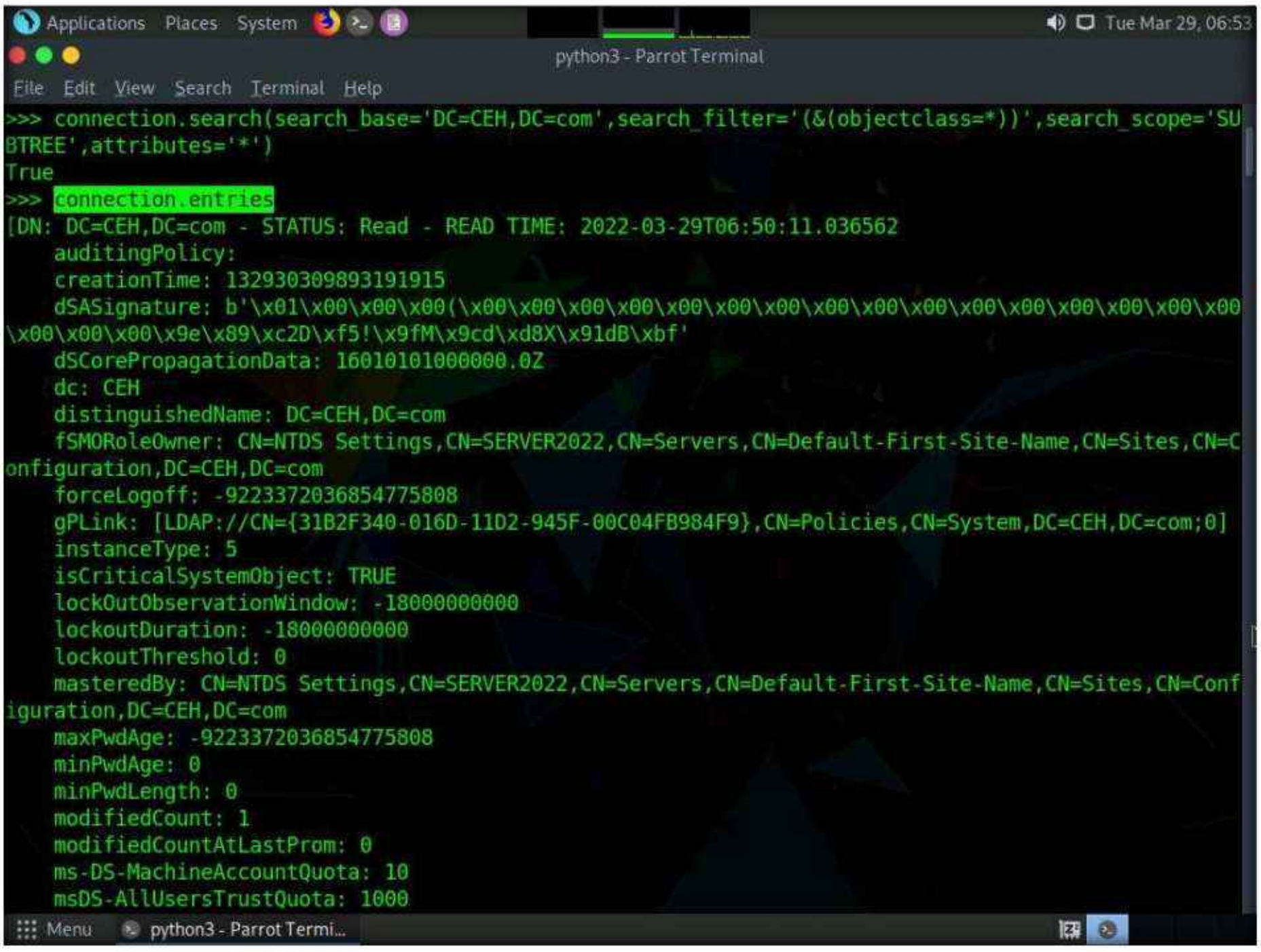
20. Type **connection.bind()** and press **Enter** to bind the connection. We will receive response as **True** which means the connection is established successfully



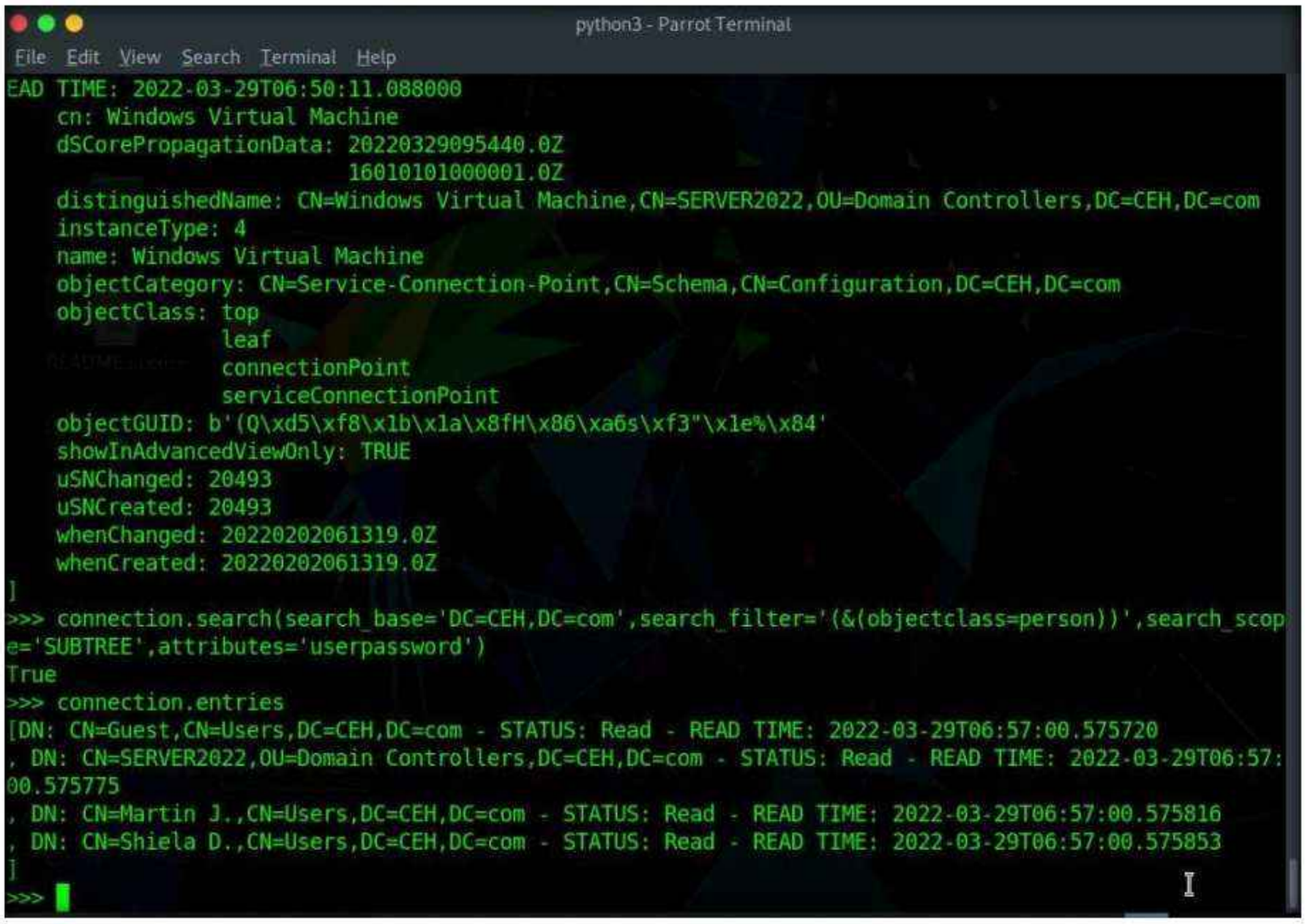
21. Type **server.info** and press **Enter** to gather information such as naming context or domain name, as shown in the screenshot below.



22. After receiving the naming context, we can make more queries to the server to extract more information.
23. In the terminal window, type **connection.search(search_base='DC=CEH,DC=com',search_filter='(&(objectclass=*))',search_scope='SUBTREE', attributes='*')** and press **Enter**.
24. Type **connection.entries** and press **Enter** to retrieve all the directory objects.



25. In the python3 shell, type **connection.search(search_base='DC=CEH,DC=com',search_filter='(&(objectclass=person))',search_scope='SUBTREE', attributes='userpassword')** and press **Enter**. **True** response indicates that the query is successfully executed.
26. Type **connection.entries** and press **Enter** to dump the entire LDAP information.



27. Using this information attackers can launch web application attacks and they can also gain access to the target machine.
28. This concludes the demonstration of LDAP enumeration using Nmap and Python.
29. Close all open windows and document all the acquired information.

Task 3: Perform LDAP Enumeration using ldapsearch

ldapsearch is a shell-accessible interface to the ldap_search_ext(3) library call. ldapsearch opens a connection to an LDAP server, binds the connection, and performs a search using the specified parameters. The filter should conform to the string representation for search filters as defined in RFC 4515. If not provided, the default filter, (objectClass=*), is used.

Here, we will use ldapsearch to perform LDAP enumeration on the target system.

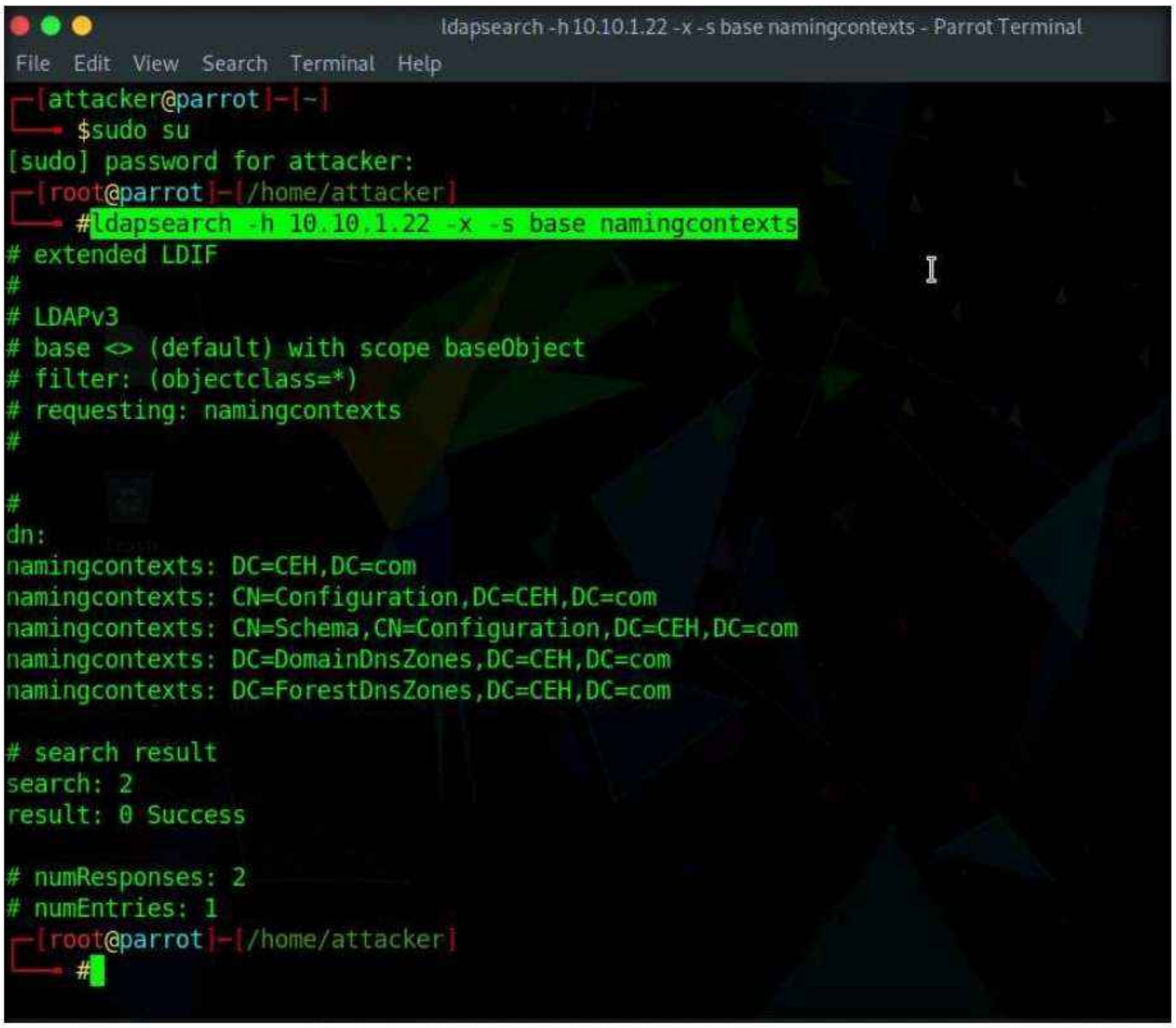
Note: Ensure that the **Windows Server 2022** virtual machine is running.

1. In **Parrot Security** virtual machine, click the **MATE Terminal** icon at the top-left corner of the **Desktop** to open a **Terminal** window.
2. A **Parrot Terminal** window appears. In the terminal window, type **sudo su** and press **Enter** to run the programs as a root user.
3. In the **[sudo] password for attacker** field, type **toor** as a password and press **Enter**.

   Note: The password that you type will not be visible.

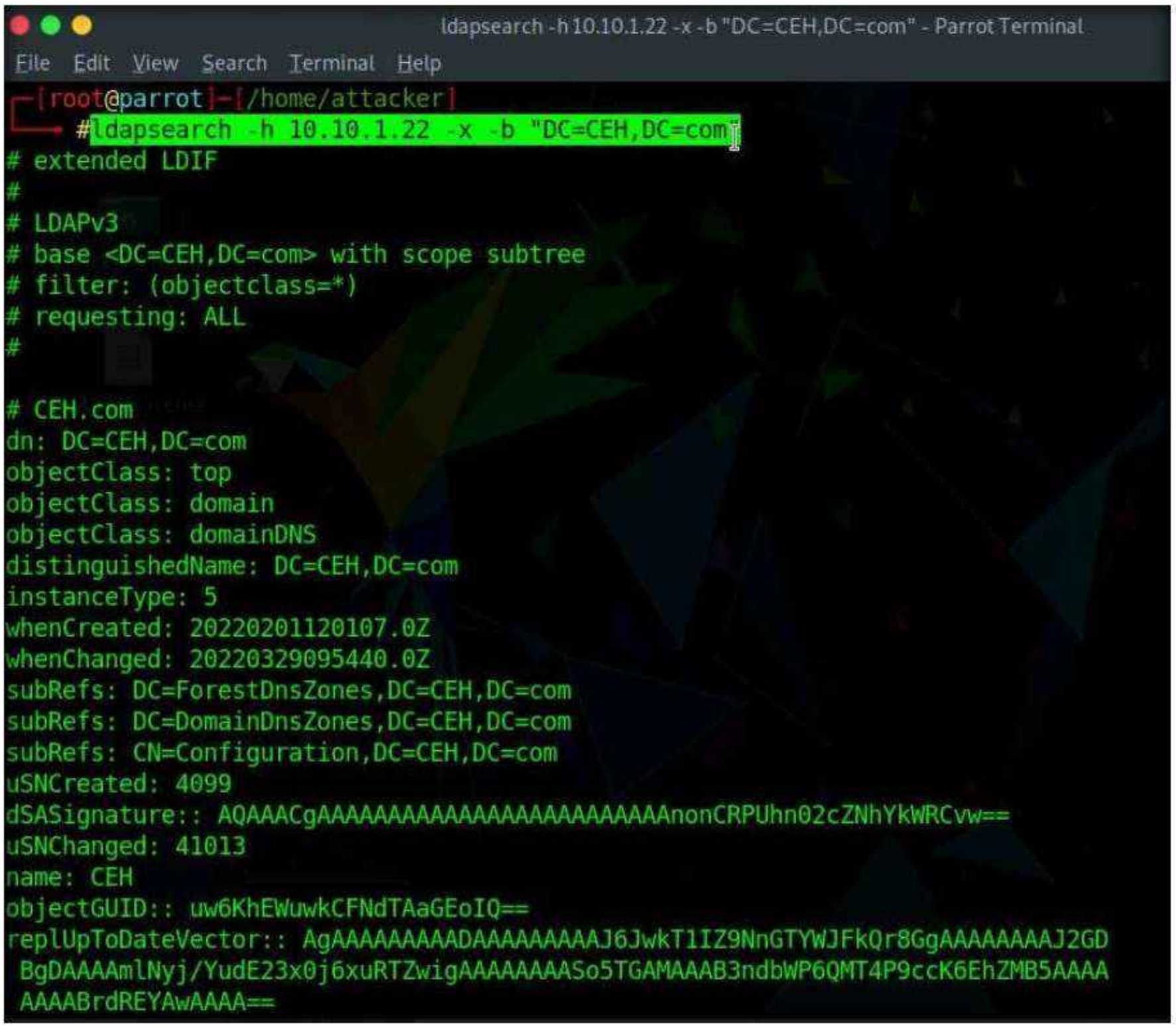
4. In the terminal, type **ldapsearch -h [Target IP Address] -x -s base namingcontexts** and press **Enter** (here, the target IP address is **10.10.1.22**), to gather details related to the naming contexts.

   Note: **-x**: specifies simple authentication, **-h**: specifies the host, and **-s**: specifies the scope.



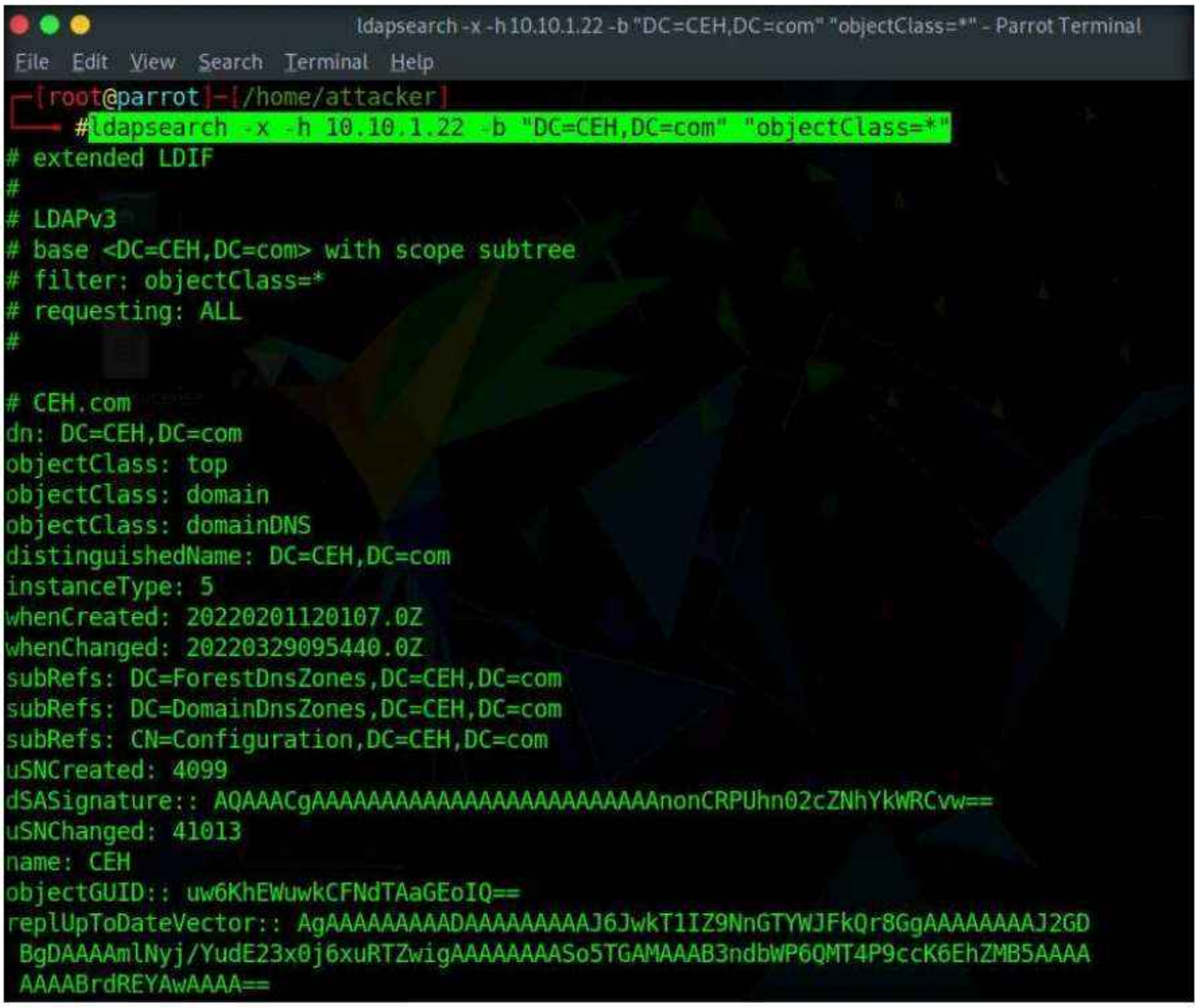
5. Type **ldapsearch -h [Target IP Address] -x -b "DC=CEH,DC=com"** and press **Enter** (here, the target IP address is **10.10.1.22**), to obtain more information about the primary domain.

   Note: **-x**: specifies simple authentication, **-h**: specifies the host, and **-b**: specifies the base DN for search.



6. Type **ldapsearch -x -h [Target IP Address] -b "DC=CEH,DC=com" "objectclass=*"** and press **Enter** (here, the target IP address is **10.10.1.22**), to retrieve information related to all the objects in the directory tree.

   Note: **-x**: specifies simple authentication, **-h**: specifies the host, and **-b**: specifies the base DN for search.



7. Attackers use ldapsearch for enumerating AD users. It allows attackers to establish connection with an LDAP server to carry out different searches using specific filters.
8. This concludes the demonstration of performing LDAP enumeration using ldapsearch.
9. Close all open windows and document all the acquired information.
10. Turn off the **Windows Server 2022** and **Parrot Security** virtual machines.

Lab Analysis

Analyze and document the results of this lab exercise.

PLEASE TALK TO YOUR INSTRUCTOR IF YOU HAVE QUESTIONS RELATED TO THIS LAB.

Internet Connection Required	
☐ Yes	☑ No
Platform Supported	
☑ Classroom	☑ CyberQ

Lab 4

Perform NFS Enumeration

NFS enumeration is a method by which exported directories and shared data on target systems is extracted.

Lab Scenario

As a professional ethical hacker or penetration tester, the next step after LDAP enumeration is to perform NFS enumeration to identify exported directories and extract a list of clients connected to the server, along with their IP addresses and shared data associated with them.

After gathering this information, it is possible to spoof target IP addresses to gain full access to the shared files on the server.

Lab Objectives

- Perform NFS enumeration using RPCScan and SuperEnum

Lab Environment

To carry out this lab, you need:

- Windows Server 2019 virtual machine
- Parrot Security virtual machine
- Web browsers with an Internet connection
- Administrator privileges to run the tools

Lab Duration

Time: 10 Minutes

Overview of NFS Enumeration

NFS (Network File System) is a type of file system that enables computer users to access, view, store, and update files over a remote server. This remote data can be accessed by the client computer in the same way that it is accessed on the local system.