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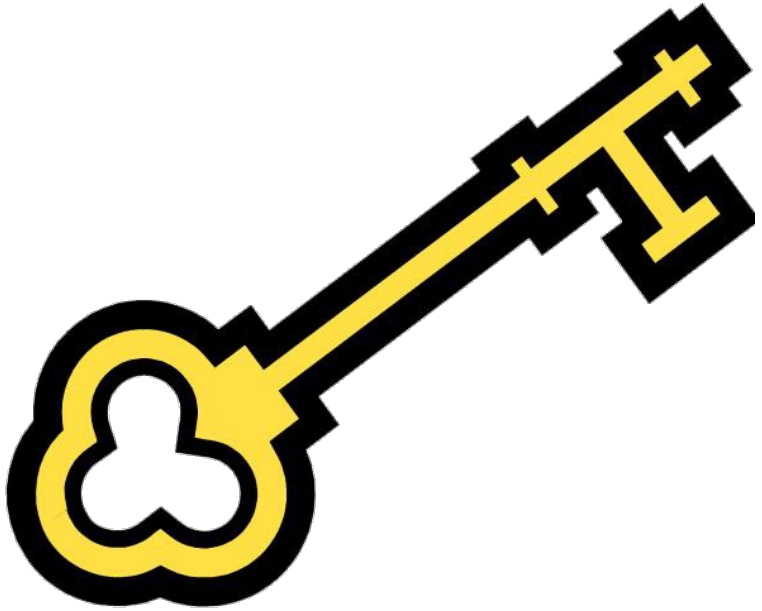
Packet Sniffing Lab



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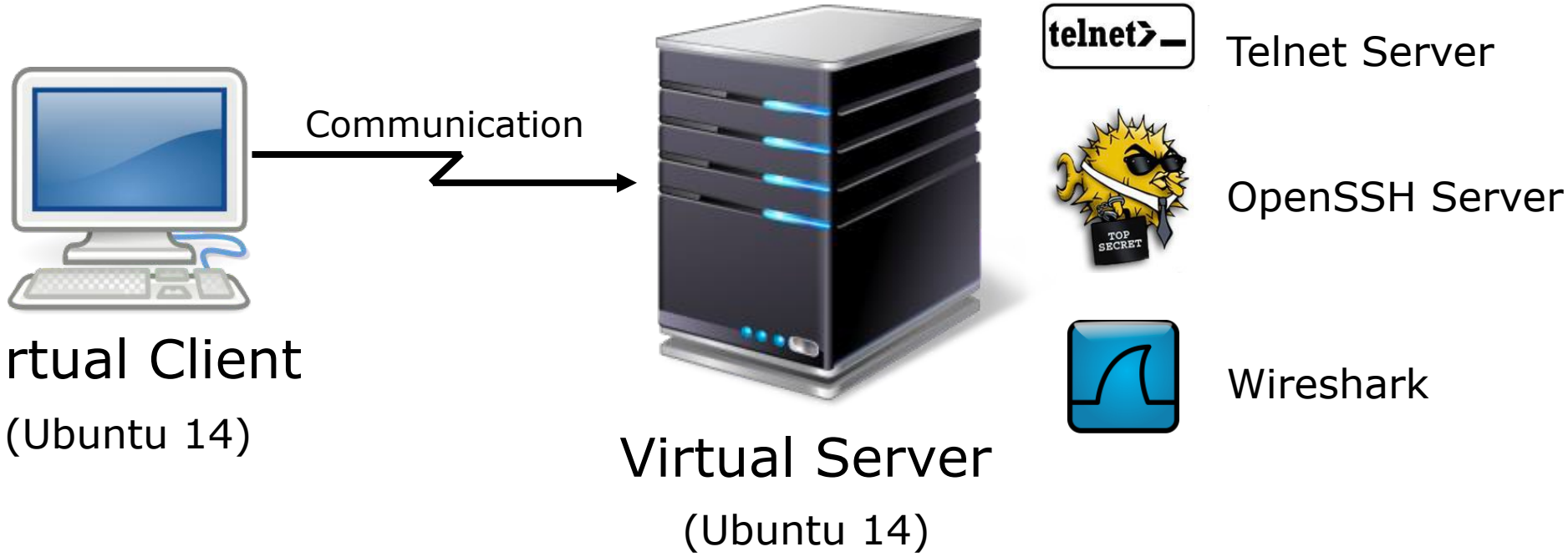
Purpose

- Understanding network packets and protocols
- Using Wireshark to capture and analyze network packets

Virtual Lab Setup

- Two VM instances within the same subnet will be used



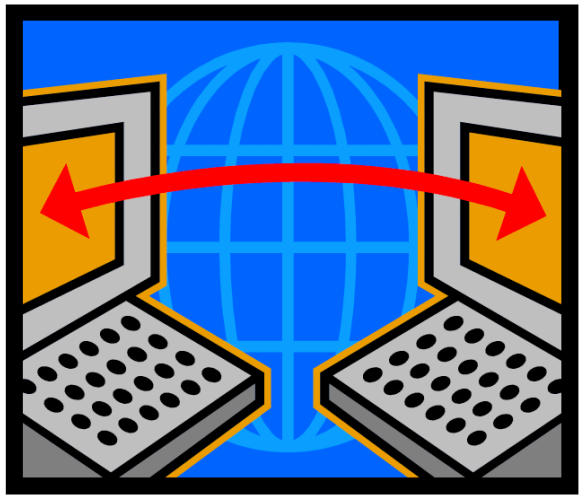
Lab Structure

- The *Packet Sniffing* lab consists of 5 experiments
  1. Telnet
  2. SSH
  3. TCP Traffic Analysis
  4. UDP Traffic Analysis

Lab Software Tools

For this lab we will be using the following tools:

- **Telnet Client/Server:** The client establishes a remote connection to the server using Telnet protocol.
- **SSH Client and Server:** The SSH client establishes a remote connection to the SSH server using the *Secure Shell (SSH)* protocol.



Lab Software Tools

- **Wireshark:** Analyzes all packets of a network interface
  - We will use Wireshark to analyze all communications between the client and the server VMs
  - Wireshark will obtain all transferred information, including client's username and password
  - Confidentiality property of cybersecurity will be violated

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Experiment 0:
Getting ready to start

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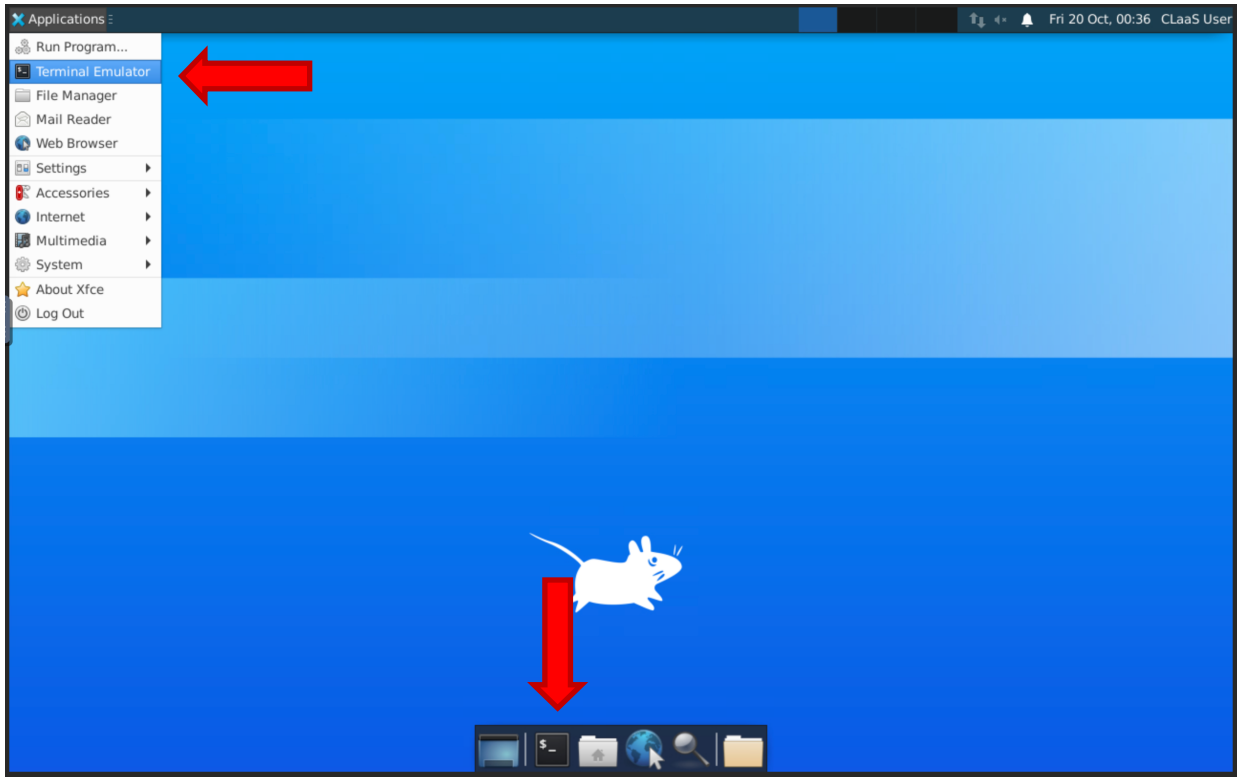
Experiment Instructions

- Step 1: Open a terminal
  - For this lab we will be using the terminal.
  - There are two ways to open it.
    - From the menu
    - Or by clicking the icon on the dock:

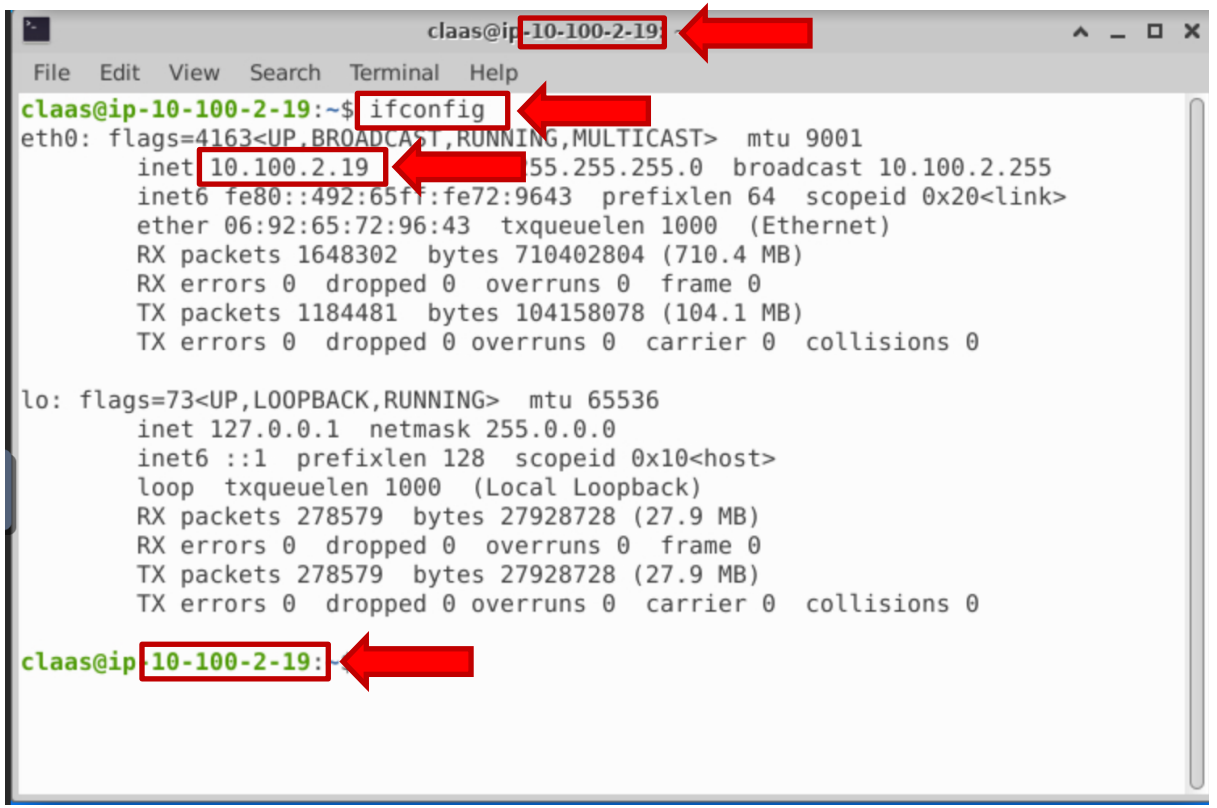


Experiment Instructions

- Step 2: Get the IP addresses
  - We can see the IP address as soon as we open the terminal
  - Or by typing

    ```
    ifconfig
    ```

  - *You will need the IP of the two VMs, for the rest of the lab.*



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Experiment 1: Telnet

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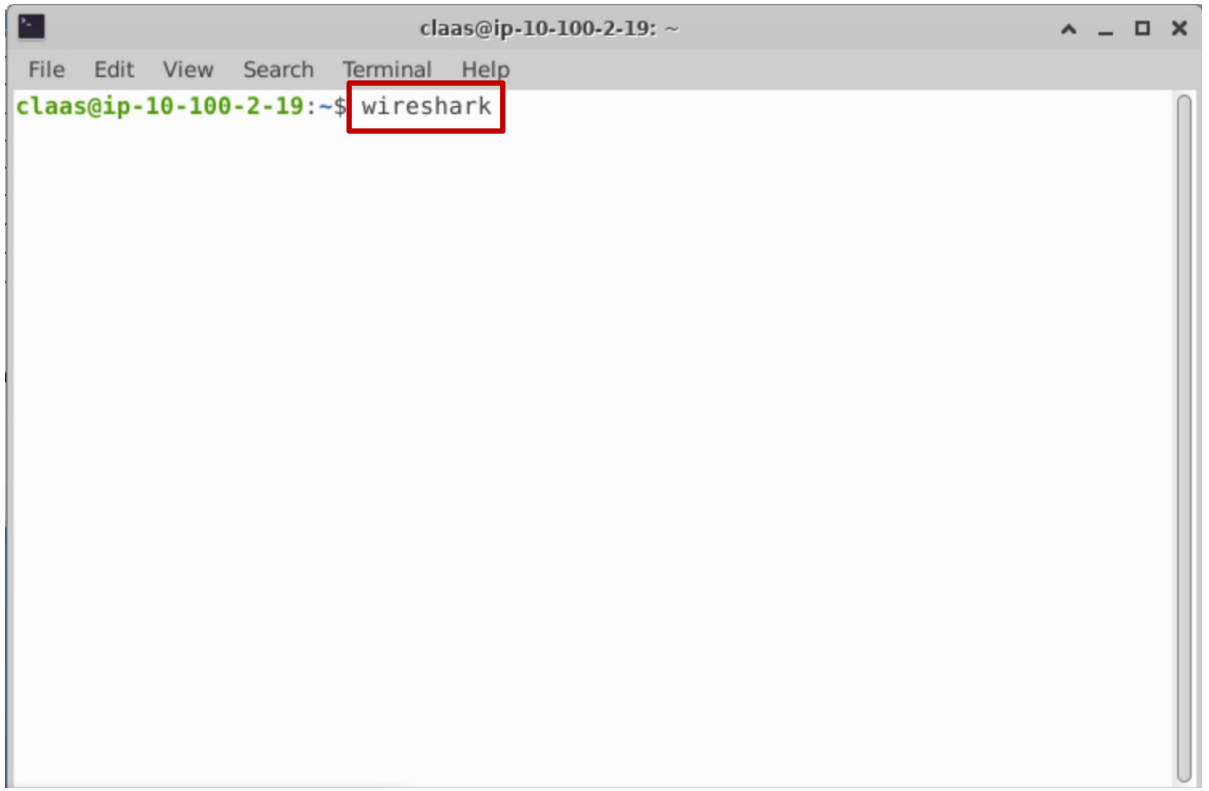
Experiment Instructions

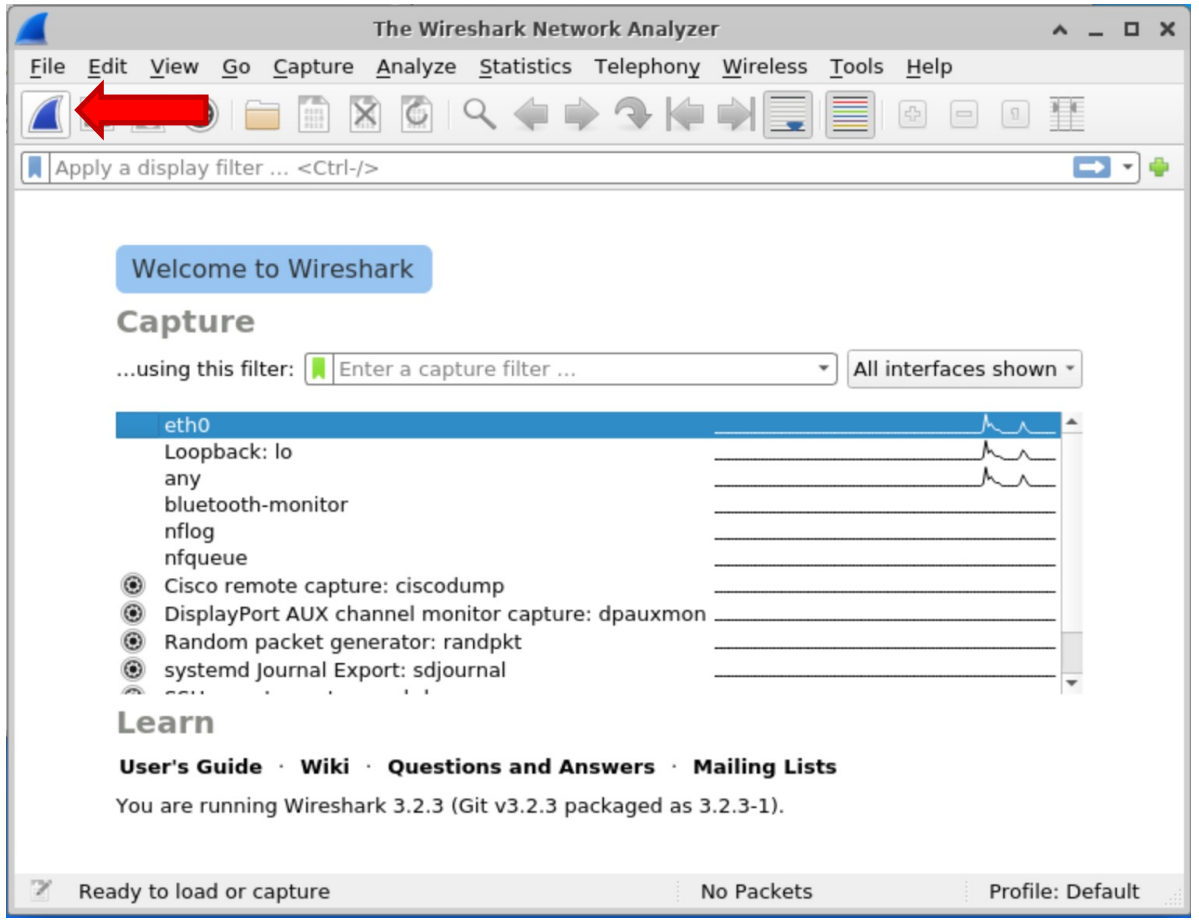
- Step 1: Open Wireshark
  - On the Server VM
  - Open a terminal and type

```
wireshark
```



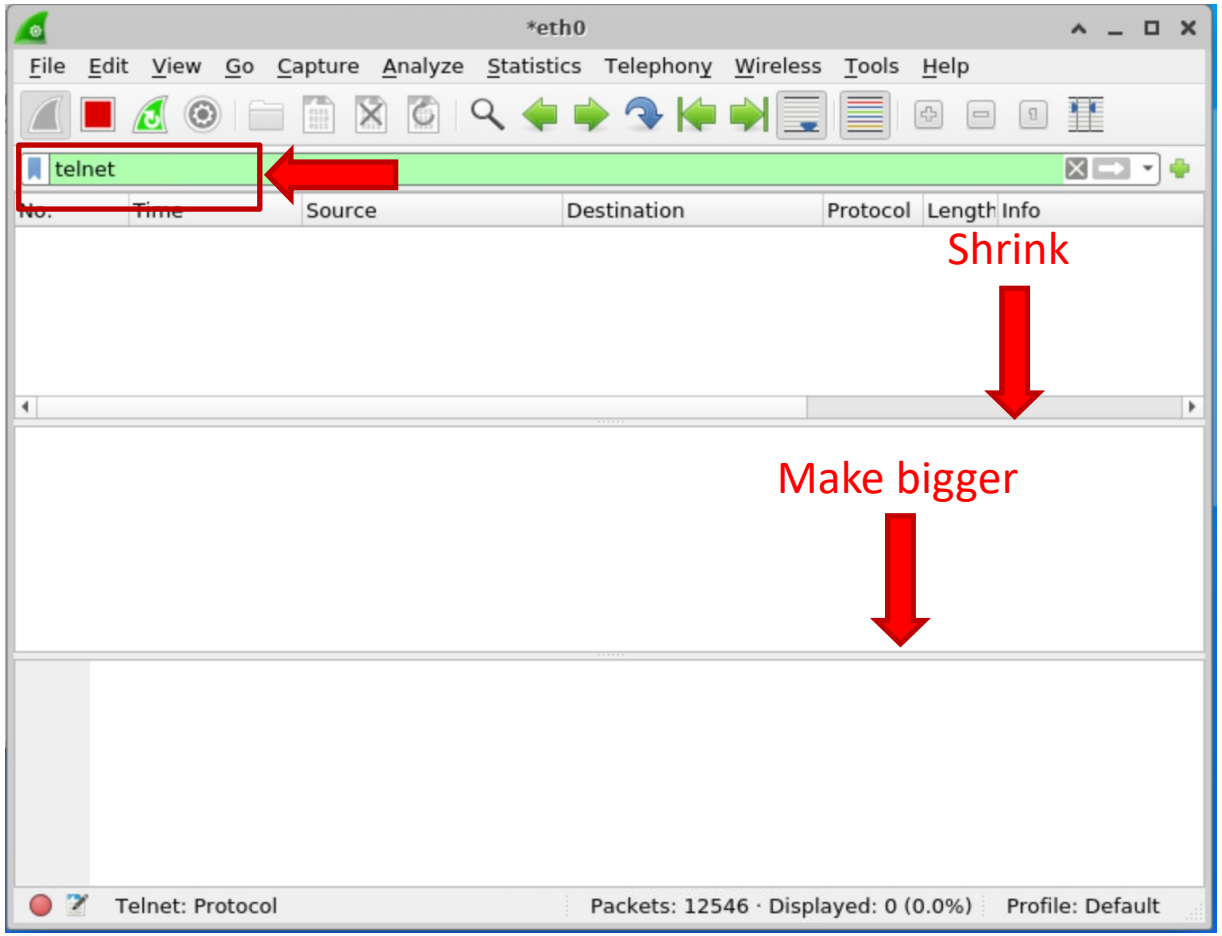
Experiment Instructions

- Step 2: Prepare Wireshark
  - Once Wireshark is open select the *eth0* interface
  - Click the blue button to *Start capturing packets*



Experiment Instructions

- Step 3: Filter Telnet packets
  - In the filter field, type *telnet* to filter only telnet packets
  - Adjust the windows, this way we'll be able to see the packets better

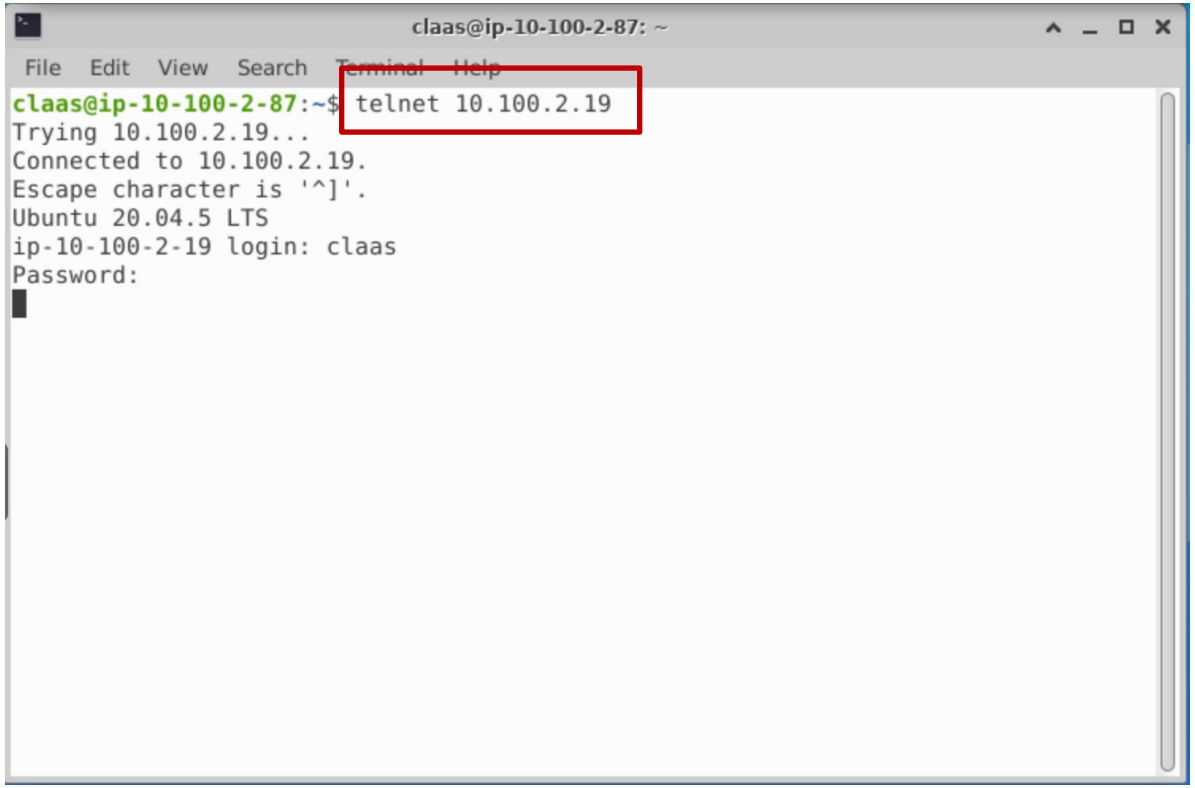


Experiment Instructions

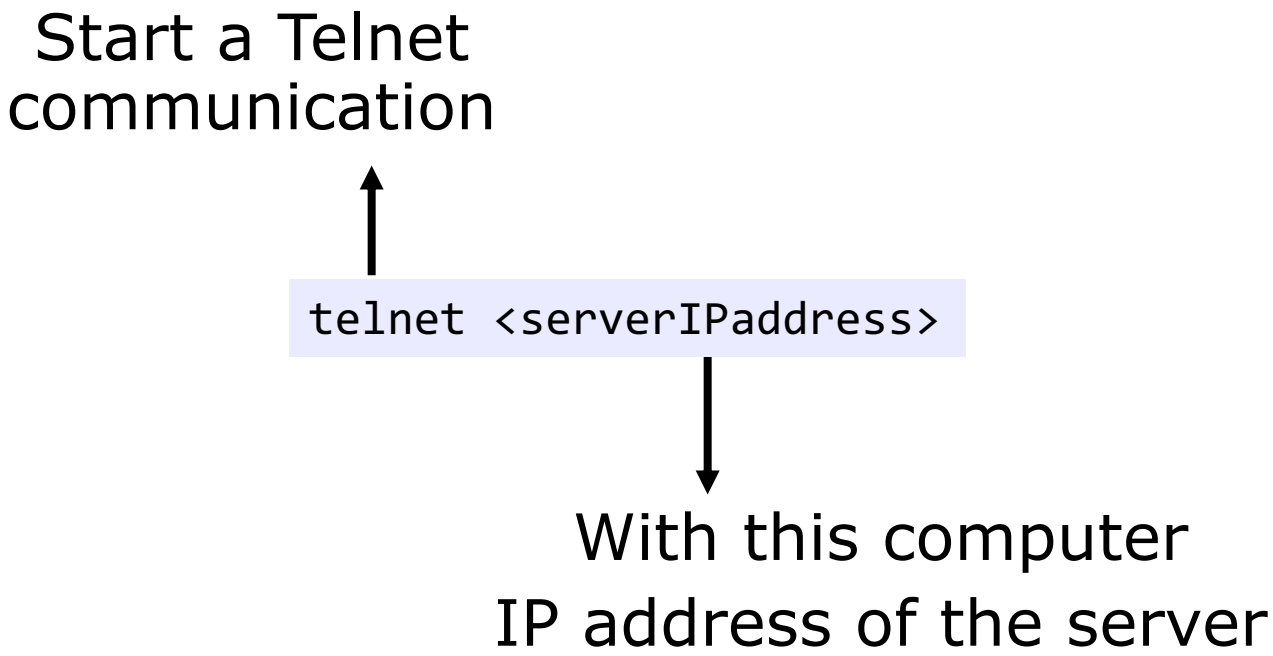
- Step 4: Generate Telnet packets
  - Go back to the Client VM
  - Open a terminal, and type

```
telnet <serverIPaddress>
```

  - Once connected type:
    - Username: *claas*
    - Password: *Claas2022*



Command Explained



- Exit your Telnet session by pressing **Ctrl+C**
- Or type **exit**

Experiment Instructions

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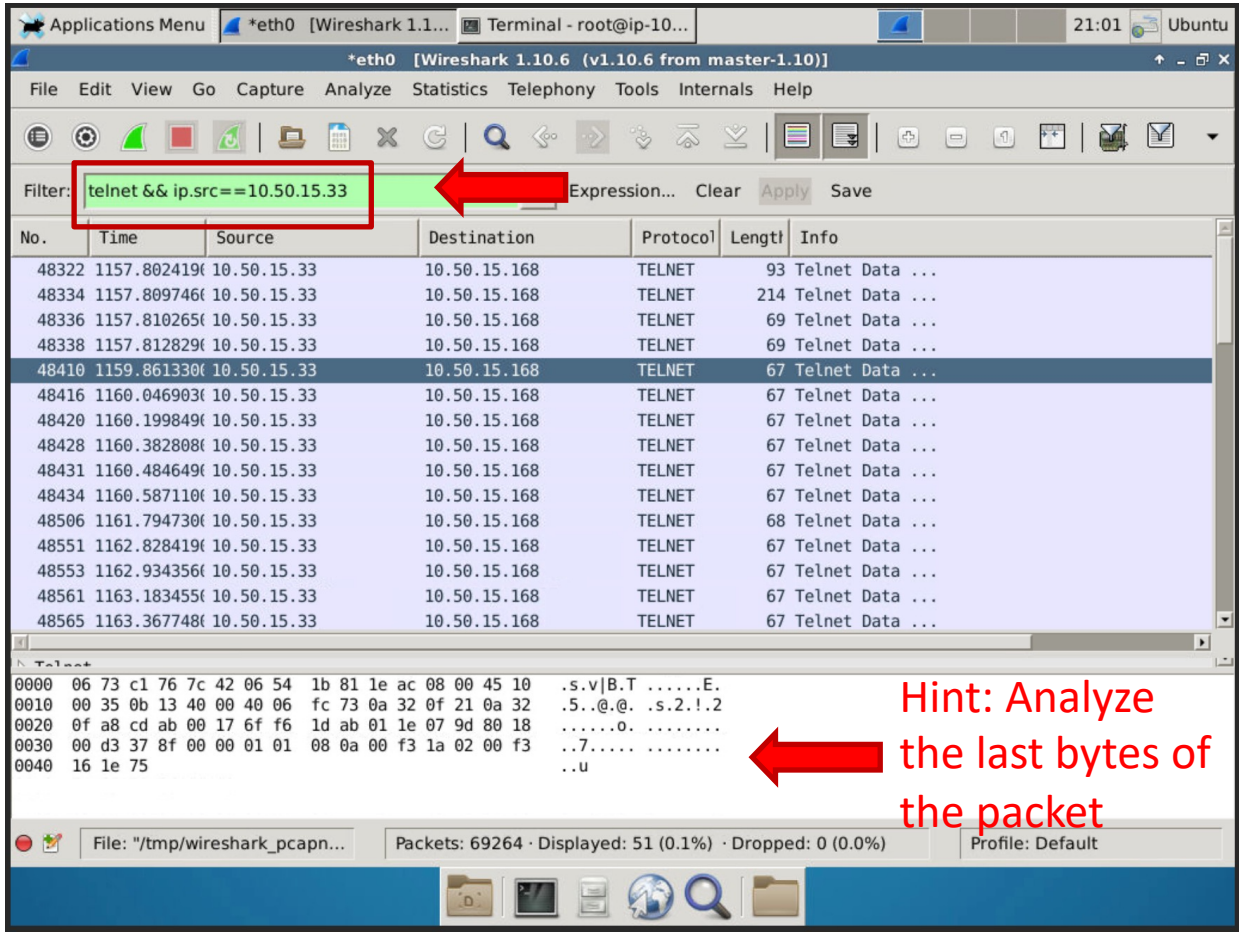
- Step 5: Analyze Telnet packets
  - Go back to Wireshark in the Server VM
  - Analyze the packets captured from the Telnet session
  - Hint: You might want to filter also by IP, to do this type on the filter field:

```
telnet && ip.src==<clientIPaddress>
```



Experiment Summary

- **Please note**
  - Telnet sends all packets (including username and password) in plaintext
  - An attacker would have no difficulty reading it using Wireshark
  - After retrieving the credentials, the attacker can connect to the server and have the same access privileges as the client

Lab Report

- Analyze the Telnet packets captured by Wireshark and describe them
- Describe the steps and their results in the report
- Obtain the username and password and some commands sent from the client, include them in your lab write-up, and explain how you have obtained them from Wireshark

How do you prevent such attacks?

- This security issue can be remedied if a communication protocol with encryption is used to transfer information between client and server machines.
- Unlike Telnet, the SSH protocol does not transmit data in plaintext. It encrypts transmitted data so that, even if attackers intercept the data, it is incomprehensible and thus still secure.

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Experiment 2: SSH

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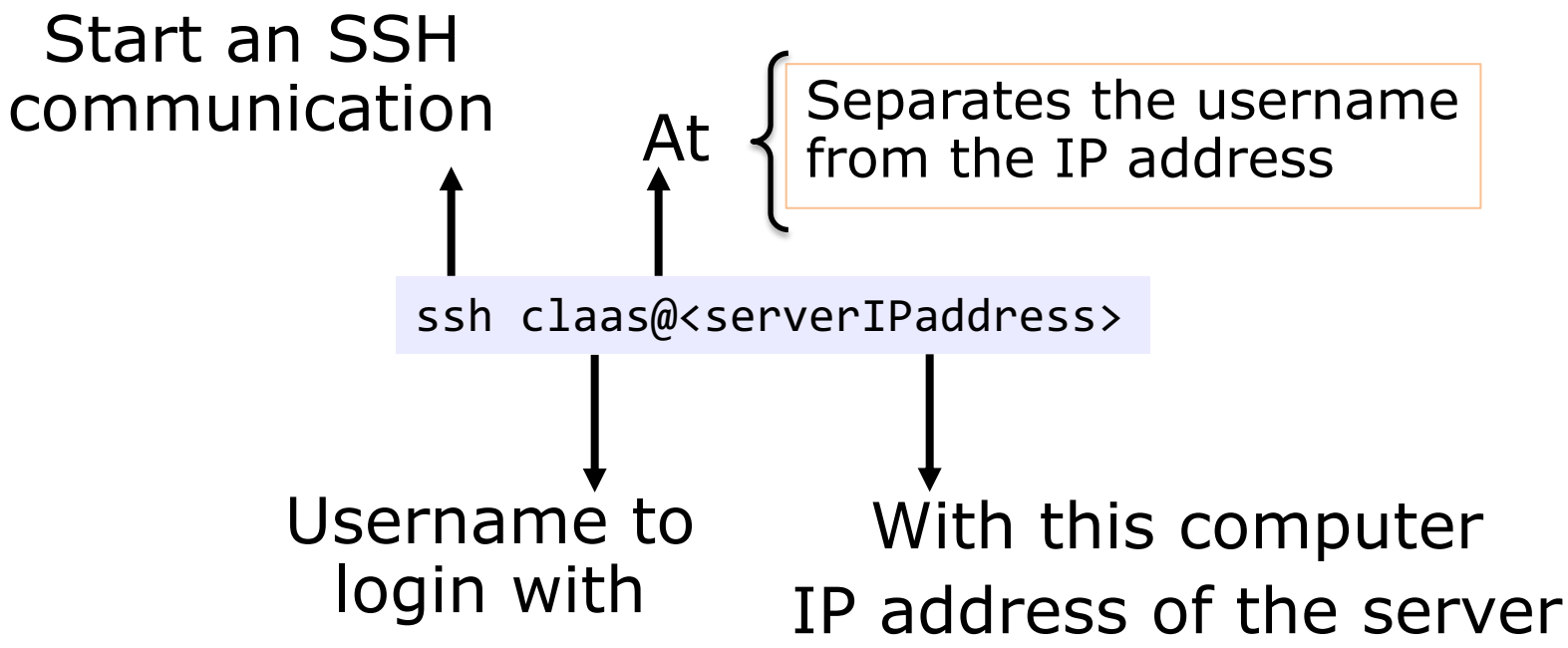
Experiment Instructions

- For this experiment, you will follow the same steps as in the Telnet experiment, with these differences:
  - In step 3 we will filter SSH instead of Telnet packets
  - For step 4, on the terminal you'll type:

```
ssh claas@<serverIPaddress>
```

  - After this, it will ask you if you want to establish a connection, type *yes*, and type the password *Claas2022*
  - Proceed with the next steps

Command Explained



- Exit your SSH session by pressing **Ctrl+C**
- Or type **exit**

Experiment Summary

- **Please note**
  - SSH uses encrypted packets
  - An attacker will fail to understand the contents without decrypting it

Lab Report

- Analyze the SSH packets captured by Wireshark and describe them
- Describe the steps and their results in the report
- Can you obtain a username and password, or any useful information sent via SSH? Justify your answer

Other features of Wireshark

- With Wireshark, you can also analyze the packet structure

- For the next experiments, you won't only view the contents of the packet, but also the multiple layers of encapsulation that go into creating a packet

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Experiment 3: TCP Traffic Analysis

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Experiment Instructions

- Step 1: Connect to a webpage
  - On the Server VM, you will use Elinks (a web-based browser)
  - Connect to a webpage typing

```
elinks www.google.com
```

  - Exit the terminal-based website by typing **Ctrl+C**

Experiment Instructions

- Step 2: Observe the TCP packets on Wireshark.
  - Go back to Wireshark and type on the filter field:

```
tcp
```

  - Go through the packets in the list and observe the following:
    - Source and destination IPs
    - Source and destination port numbers on both the client and server
    - The packet parameters
    - Maximum and minimum values of these parameters

Experiment Instructions

- Step 3: Change the display filter to *HTTP*
  - Go through the packets in the list and add the following information to your lab report:
    - Describe the HTTP commands and their parameters
    - What are the maximum and minimum values of these parameters?
    - What are the listed HTTP headers and what are their values? (Some HTTP packets may not have headers)

Experiment Summary

- **Please note**
  - The TCP protocol includes error checking and packet ordering information
  - HTTP is a TCP protocol

Lab Report

- List source and destination IPs and port numbers from the captured TCP packets
- List TCP packet parameters and maximum/minimum values

- Describe HTTP commands and their parameters (include max/min values)
- List HTTP headers and their values

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Experiment 4: UDP Traffic Analysis

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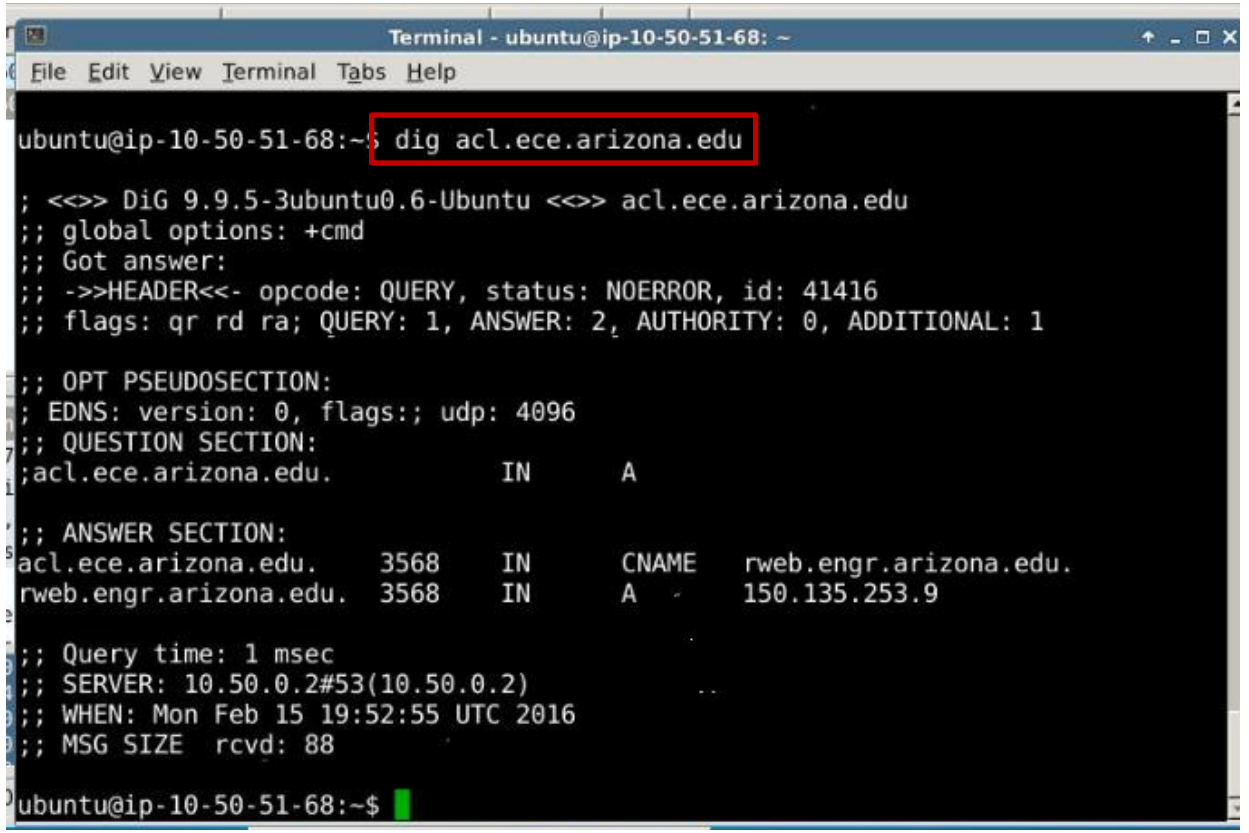
Experiment Instructions

- Step 1: Generate DNS traffic
  - From the terminal on the Server VM, type the following to generate DNS traffic:

```
dig acl.ece.arizona.edu
```



Experiment Instructions

- Step 2: Observe the UDP packets on Wireshark.
  - Go back to Wireshark and type on the filter field:

```
udp
```

  - Go through the packets in the list and observe the following:
    - Source and destination IPs
    - Source and destination port numbers on both the client and server
    - The packet parameters
    - Maximum and minimum values of these parameters

Experiment Instructions

- Step 3: Observe the DNS packets on Wireshark.
  - Go back to Wireshark and type on the filter field:

```
dns
```

  - Examine the listed packets and find the following information:
    - DNS headers
    - Maximum and minimum values of these headers
    - The listed queries and answers

Experiment Instructions

- Step 4: Generate more DNS packets
  - Look up at least four domain names with the dig command on a terminal in the Server VM
  - Go back to Wireshark and examine the DNS packets you created. Add the following to your lab report:
    - What information does a DNS request packet contain?
    - What information does a DNS reply packet contain?
    - Which resource is handling each DNS request for each domain name?
    - How many steps are required to obtain an IP address for each request?

Experiment Summary

- **Please note**
  - The UDP protocol is connectionless
  - DNS is a UDP protocol
  - The DNS protocol can have a variety of data sources, including authoritative name servers and resolvers

Lab Report

- List source and destination IPs and port numbers from the captured UDP packets
- List UDP packet parameters and maximum/minimum values
- List DNS headers and their values (include max/min values)
- List DNS queries and answers from captured packets

- What information does a DNS request packet contain?
- What information does a DNS reply packet contain?
- Which resource is handling each DNS request for each domain name?
- How many steps are required to obtain an IP address for each request?

Conclusion

- Wireshark is a very powerful tool that can have a variety of uses in computer and network security.
- In this lab, we barely scratched the surface of Wireshark's capabilities as a packet analyzer.
- We also experimented with different protocols and their structures.

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End of Lab

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