Lab Sheet 2

(12-12-2023)

Objective: To understand few more basic network commands and to identify the connection issues if any and to transfer files to a remote machine from your machine.

General Instructions:

- Students are expected to work Ubuntu OS based systems.
- If any command is not installed on your system, do install using **sudo apt-get install <relevant command related_name>** on the Terminal
- To see more details about any command, type **man <command_name>** on the Terminal.
- Running **<command_name> -h** on your Terminal will display the help menu of that command.

Network Commands:

Run the following commands on your Terminal window.

1. traceroute

The syntax of *traceroute* command is
traceroute [...] host [...]
[...] is the set of options.

If **traceroute** isn't installed by default on Ubuntu. Use the following command to install it:
sudo apt-get install traceroute

traceroute command prints the route that a packet takes to reach the host. This command is useful when you want to know about complete route (or path) to reach a given destination or host including all the hops in between. This command can also be useful for troubleshooting network connectivity issues, e.g., Traceroute command helps us to find out the connectivity problem if any along the route to a given destination.
Note: tracert command can be used on windows OS to get the same result.

When you run the traceroute command, it sends a series of packets (three) to the destination IP address or domain, with each packet taking a different route through the network. Along the way, the traceroute tool records the time it takes for each packet to reach intermediate routers or servers. The result is a list of the IP addresses of the routers or servers through which the packets traveled, along with the time taken for each hop.

Note: It displays the details for a maximum of 30 hops in between the source and the destination host.

For example: Print out all the hops between your machine and the host (google.co.in). It is shown in the below image.

```
sivakumar@sivakumar:~$ traceroute google.co.in
traceroute to google.co.in (142.250.183.227), 30 hops max, 60 byte packets
 1  sivakumar.mshome.net (172.31.80.1)  0.534 ms  0.500 ms  0.484 ms
 2  172.21.136.1 (172.21.136.1)  85.435 ms  85.421 ms  85.409 ms
 3  192.168.130.10 (192.168.130.10)  9.667 ms  9.653 ms  9.638 ms
 4  182.73.65.57 (182.73.65.57)  9.592 ms  9.580 ms  9.568 ms
 5  116.119.68.242 (116.119.68.242)  28.221 ms 182.79.236.125 (182.79.236.125)  51.183 ms 116.119.94.24 (116.119.94.24)
28.202 ms
 6  142.250.169.206 (142.250.169.206)  28.185 ms  32.002 ms  31.981 ms
 7  * * *
 8  108.170.253.97 (108.170.253.97)  28.335 ms  28.327 ms 216.239.56.62 (216.239.56.62)  24.579 ms
 9  108.170.253.103 (108.170.253.103)  24.542 ms 209.85.247.251 (209.85.247.251)  24.703 ms  28.100 ms
10  maa05s23-in-f3.1e100.net (142.250.183.227)  22.761 ms  27.183 ms  27.158 ms
```

Another Example: Tracerouting host (amazon.in)

```
sivakumar@sivakumar:~$ traceroute amazon.in
traceroute to amazon.in (54.239.33.92), 30 hops max, 60 byte packets
 1  sivakumar.mshome.net (172.31.80.1)  0.616 ms  0.573 ms  0.554 ms
 2  172.21.136.1 (172.21.136.1)  52.901 ms  52.885 ms  52.870 ms
 3  192.168.130.10 (192.168.130.10)  5.293 ms  5.282 ms  5.267 ms
 4  182.73.65.57 (182.73.65.57)  13.984 ms  13.974 ms  13.904 ms
 5  182.79.134.111 (182.79.134.111)  136.822 ms 182.79.154.153 (182.79.154.153)  177.344 ms 182.79.134.146 (182.79.134.146)  136.785 ms
 6  amsix01-ams1.amazon.com (80.249.210.100)  219.335 ms  216.898 ms  195.687 ms
 7  52.93.113.175 (52.93.113.175)  264.884 ms 52.93.113.181 (52.93.113.181)  261.953 ms 52.93.113.175 (52.93.113.175)  283.338 ms
 8  * * *
 9  52.93.0.243 (52.93.0.243)  267.516 ms 52.93.0.215 (52.93.0.215)  260.114 ms  260.091 ms
10  52.93.0.43 (52.93.0.43)  258.528 ms 52.93.0.57 (52.93.0.57)  258.055 ms 52.93.0.77 (52.93.0.77)  284.765 ms
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Subtasks:

a) traceroute to gitam.edu, google.co.in, then find out the IP address of the first hop router?
b) How many packets are sent from your system?
c) Observe the latency for every hop. Is it the same at every hop or not? Yes or No, justify your answer.
d) Display the route of your friend's system by specifying his/her IP address.
e) Try a different website and list of all ISPs which your search explored.

2. scp

The Secure Copy Protocol (SCP) in Linux is a network protocol that allows the secure transfer of files between a local host and a remote host or between two remote hosts. It uses SSH (Secure Shell) protocol for authentication and data encryption, providing a secure and efficient way to transfer files. SCP is a command-line tool widely used in Linux and Unix systems for file transfer over a network.

The syntax of scp command is

scp [...] username@]host1:file1path user@host2:locationpath
where [...] is the set of options.

Here,

- scp:- It initializes the command and establishes a secure shell to ensure secure connectivity.
- OPTIONS:- It is responsible for setting up the necessary permissions depending upon the requirement, such as:
  - P:- Used to specify the port for connecting with the remote server.
  - p:- Used to store timestamps of different events during the transfer.
  - r:- Recursively copy all directories.
  - q:- Used to silently copy files.
  - C:- Used for data compression during the file transfer.
- SOURCE_HOST:- Server or client that hosts the file to be transferred.
- DESTINATION_HOST:- Server or client where the file is to be copied.

How does SCP Command Work?

The SCP (Secure Copy) command in Linux works by establishing a secure SSH (Secure Shell) connection between the local and remote hosts and transferring files over the encrypted connection.

When you run the SCP command, it authenticates your credentials (username and password) on the remote host using the SSH protocol. It then creates a secure tunnel over the network and copies the files to or from the remote host.

It also supports several advanced features, such as compression and remote file copy, etc.

Prerequisites: Before you make use of the SCP commands, make sure you have the following things in place:

- SSH needs to be installed on both the host and the destination server or machine.
- Root access to both the client and server machines. So, you should use **sudo** command along with **scp** command.

Installation:

Transferring Files from Local to Remote Ubuntu System Using SCP

To transfer files from your local Ubuntu system to a remote Ubuntu system using SCP (Secure Copy Protocol), follow these steps:
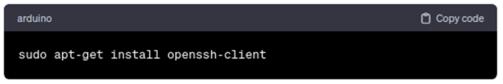
1. **Install OpenSSH Server on Remote Ubuntu:**
   - Use the following command to install the OpenSSH server on the remote Ubuntu system.

```arduino
sudo apt-get install openssh-server
```

2. **Ensure SCP is Installed on Local Ubuntu:**
   - Confirm that SCP is installed on your local Ubuntu system. If not, you can install it using:

```arduino
sudo apt-get install openssh-client
```

After installing openssh-server, scp access would be enabled by default.

List of activities to be done in the lab session:

1. **Securely login to a remote system.**
   Use the below command to login to a remote system securely to your system.

For example, to login to a remote system, whose username is sys1 and its ip address is 172.21.49.157, execute the below command.

```
sys2@sys2-Vostro-3470:~$ ssh sys1@172.21.49.157
sys1@172.21.49.157's password: █
```

Note: You are required to change the IP address as per your remote system.

Note: It will ask for the password, you need to enter the password of the remote system as shown below:

```
sys2@sys2-Vostro-3470:~$ ssh sys1@172.21.49.157
sys1@172.21.49.157's password:
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-150-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

68 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

New release '20.04.6 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Your Hardware Enablement Stack (HWE) is supported until April 2023.
Last login: Wed Dec  6 13:01:57 2023 from 172.21.50.35
```

The above confirms that you connect to the remote and allows you to do anything you want on that remote system. To exit the login of the remote system, just type **exit**

2. **Copy Local File(s) to a Remote System**

To copy a file from a local host to a remote server in Linux using the SCP command, follow the below steps:

> Open the terminal on the local host.

Use the scp command with the following syntax:

scp /path/to/local/file username@remote_host:/path/to/remote/directory

Here, replace "/path/to/local/file" will path of the file you want to copy from your local system. "username" is the username of the remote host, "remote_host" could be the IP address or hostname of the remote server, and "/path/to/remote/directory" will be the path of the directory where you want to copy the file on the remote server.

Task 2.1: Example of a Copying a text file from your system to a remote server:

```
sys2@sys2-Vostro-3470:~$ scp /home/sys2/Desktop/Lab2/one.txt sys1@172.21.49.157:/home/sys1/Desktop/skr
sys1@172.21.49.157's password: █
```

It will ask for password of the remote system, you enter adn then it will be copied to the remote machine as shown below:

```
sys2@sys2-Vostro-3470:~$ scp /home/sys2/Desktop/Lab2/one.txt sys1@172.21.49.157:/home/sys1/Desktop/skr
sys1@172.21.49.157's password:
one.txt                                                              100%   28    28.2KB/s   00:00
sys2@sys2-Vostro-3470:~$
```

Note1: The above shows that a file (one.txt) is copied from my system (local) to the remote system

Note1: You can cross verify if a file is copied on remote system directly or not through remote shell login or on a remote system directly.

Task 2.2: Example of a Copying a pdf file from your system to a remote server:

```
sys2@sys2-Vostro-3470:~$ scp /home/sys2/Desktop/Lab2/dummy.pdf sys1@172.21.49.157:/home/sys1/Desktop/skr
sys1@172.21.49.157's password:
```

It will ask for password of the remote system, you enter ann then it will be copied to the remote machine as shown below:

```
sys2@sys2-Vostro-3470:~$ scp /home/sys2/Desktop/Lab2/dummy.pdf sys1@172.21.49.157:/home/sys1/Desktop/skr
sys1@172.21.49.157's password:
dummy.pdf                                                            100%   13KB   5.3MB/s
sys2@sys2-Vostro-3470:~$
```

Note1: The above shows that a pdf file (dummy.pdf) is copied from my system (local) to the remote system

Task 2.3: Example of copying all files of a directory from your system to a remote server:

```
sys2@sys2-Vostro-3470:~$ scp -r /home/sys2/Desktop/Lab2 sys1@172.21.49.157:/home/sys1/Desktop/skr
sys1@172.21.49.157's password:
```

It will ask for password of the remote system, you enter, then it will be copied to the remote machine as shown below:

```
sys2@sys2-Vostro-3470:~$ scp -r /home/sys2/Desktop/Lab2 sys1@172.21.49.157:/home/sys1/Desktop/skr
sys1@172.21.49.157's password:
one.txt                                                              100%   28    30.8KB/s   00:00
dummy.pdf                                                            100%   13KB   5.3MB/s   00:00
sys2@sys2-Vostro-3470:~$
```

Note1: The above shows that one text file (one.txt) and one pdf file (dummy.pdf) are copied from my system (local) to the remote system

3. Copy Remote File(s) to a Local System

To copy a file from a remote system to a local system using SCP command in Linux, follow the below steps:

- Open the terminal on the local system.
- Use the scp command with the following syntax:

scp   username@remote_host:/path/to/remote/file   /path/to/local/directory

This will copy files from a remote server to a local system.

Here, replace *"username"* with the username of the remote host, *"remote_host"* with the IP address or hostname of the remote server, *"/path/to/remote/file"* with the path of the file you want to copy from the remote system, and *"/path/to/local/directory"* with the path of the directory where you want to copy the file on the local system.

Task 3.1: Example of a Copying a pdf file from remote system to your system:
Pdf file name is Calendar.pdf, which was available on the desktop of the remote system.

```
sys2@sys2-Vostro-3470:~$ scp sys1@172.21.49.157:/home/sys1/Desktop/Calendar.pdf /home/sys2/Desktop
sys1@172.21.49.157's password:
```

It will ask for password of the remote system, you enter and then it will be copied to the remote machine as shown below:

```
sys2@sys2-Vostro-3470:~$ scp sys1@172.21.49.157:/home/sys1/Desktop/Calendar.pdf /home/sys2/Desktop
sys1@172.21.49.157's password:
Calendar.pdf                                            100% 7125KB  10.8MB/s   00:00
sys2@sys2-Vostro-3470:~$
```

The above shows that Calendar.pdf file was copied from a remote system to your local system's Desktop.

Cross verification:

```
sys2@sys2-Vostro-3470:~$ cd Desktop
sys2@sys2-Vostro-3470:~/Desktop$ ls
Calendar.pdf   Lab2
```

Task 3.2: Example of a Copying all files of a folder (including a directory) from remote system to your system:

Assume that Lab2 folder on a remote system contains the below files:
i) Calendar.pdf
ii) dummy.pdf
iii) one.txt
and you want copy the above files to your desktop folder, CN on to your system, then do the below:

```
sys2@sys2-Vostro-3470:~$ scp -r sys1@172.21.49.157:/home/sys1/Desktop/skr/Lab2 /home/sys2/Desktop/CN
sys1@172.21.49.157's password:
Calendar.pdf                                          100%   94KB   9.6MB/s   00:00
one.txt                                               100%   28     33.9KB/s  00:00
dummy.pdf                                             100%   13KB   5.5MB/s   00:00
```

Cross verification of copied files on your desktop:

Move to the desktop on your termina and do the followingl:

```
sys2@sys2-Vostro-3470:~$ cd Desktop/CN
sys2@sys2-Vostro-3470:~/Desktop/CN$ ls
Lab2
sys2@sys2-Vostro-3470:~/Desktop/CN$ ls Lab2
Calendar.pdf   dummy.pdf   one.txt
```

The above confirms that the files (including) a directory are copied from a remote system onto your CN folder on the desktop.

Task 4: Copy a File Between Two Remote Systems

To copy a file between two remote systems using the scp command in Linux, follow the below steps:

- Open the terminal on your local system.
- Use the scp command with the following syntax:

scp username1@remote_host1:/path/to/remote/file

username2@remote_host2:/path/to/remote/directory

Here replace *"username1"* with the username of the first remote host, *"remote_host1"* with the IP address or hostname of the first remote server, *"/path/to/remote/file"* with the path of the file you want to copy from the first remote system, *"username2"* with the username of the second remote host, *"remote_host2"* with the IP address or hostname of the second remote server, and

"/path/to/remote/directory" with the path of the directory where you want to copy the file on the second remote system.

This will copy files between two remote hosts.

Task 4.1 : Show an example of copying a single file from one remote system to another remote system.

Task 4.2 : Show an example of copying a set of files from one remote system to another remote system.

Limitations of SCP Command

Although the SCP command is a powerful and secure tool for file transfer in Linux, it has some limitations, including:

- **Limited functionality**: SCP has limited functionality compared to other file transfer protocols, such as FTP or SFTP. It does not have features like resume, directory synchronization, or remote file editing.
- **Poor performance on high-latency networks**: SCP does not perform well on high-latency networks because it uses a single connection for file transfer. This can lead to slow transfer speeds and timeouts.
- **No file browsing capability**: SCP does not allow the browsing of files on the remote system. Users need to know the exact path of the file they want to transfer.
- **No progress indicator:** SCP does not provide a progress indicator during file transfer, making it difficult to estimate transfer time.
- **No file integrity checks:** SCP does not perform file integrity checks during transfer, which can lead to file corruption if errors occur.

References:
1. https://linuxize.com/post/how-to-use-scp-command-to-securely-transfer-files/
2. https://www.freecodecamp.org/news/scp-linux-command-example-how-to-ssh-file-transfer-from-remote-to-local/

Deadline: Submit solutions to the above questions (subtasks) in a pdf file on moodle within the given deadline, i.e, 16-12-2023 11:59 PM.