IIT Goa CS212 (Computer Networks LAB)
Instructor: Neha Karanjkar

LAB 1: Basic Networking Tools and Traceroute

Instructions:

- This lab is to be completed in teams of 2 students.

- After completing the lab exercise, create a brief report (pdf) and upload it to Google classroom. Clearly write the question number of each answer. Only one person in a team needs to upload the solutions. The report must contain the names of both persons in the team.

- The report must be named: LAB1_<NAME1>_<NAME2>.pdf where NAMEs are your names as on Google classroom.

- You can use web search and online resources for completing the lab.

- The Tas/instructor will conduct a brief viva to grade your lab exercises.

PART 1:   IP and MAC Addresses, and Routing Tables

1. Read up about the `ip` command in Linux, in particular the `ip addr show` command. You should have a rough understanding of what this command does, what are its options, and how to interpret its output.

   a) List the loopback IP address

   b) List the IP address used by your computer for connecting to the internet, and state its type (IPv6 or IPv4). Also state what type of interface it belongs to (WiFi/Ethernet etc)

   c) Find out how many network interfaces your computer has. For each network interface, list down the following information:
      1. It's type (Ethernet/Wifi/Bluetooth ...)
      2. It's MAC address
      3. Manufacturer of this NIC (Network Interface Card) (this information can be inferred from the MAC address)
      4. IPv4 address or IPv6 address

2. Your computer may be part of a local network (say a lab-wide or building-wide network within IIT Goa).

a) What is the IP address of this network and what is the range of IP addresses that can belong to individual computers within this network?

b) What is the max number of hosts that can be uniquely addressed within this local network?

c) What is the IP address for sending broadcast messages to your local network?

d) What is your publicly-visible IP address (as seen by a server outside of IIT Goa)?

3. Just like a router, your computer also maintains a routing table. Each entry in this routing table contains a range of destination IP addresses and the IP address of the "next hop" that should be chosen to forward a packet with the matching destination address. In addition, there is also an entry called "default" which is the route chosen if a destination address does not match any of the other more-specific entries. For a given destination IP address, the entries in the table are searched in the order of the longest prefix to shortest prefix until a match is found. (This is called the "Longest Prefix Match" approach). When a match is found, the computer chooses this entry as the next hop for forwarding the packet. You can view your computer's routing table using the `ip route show` command in Linux. Read up about this command to get a rough understanding of what this command does, what are its options, and how to interpret its output.

a) What is your default Gateway's IP address as shown in the routing table? What is meant by a Gateway?

b) Re-write the first 3 entries of your routing table here in the format:
<destination IP-address/prefix-length>, <next hop's IP address where this packet should be forwarded>

c) Sometimes, the next hop's IP address may be shown as 0.0.0.0. Find out what this means (using web search)

d) You might notice an address that looks like 169.254.x.x. What are such addresses called and what do they indicate?

PART 2: PING and TRACEROUTE

4. Explore the 'Ping' command, and report the approximate round-trip time for a ping to :
a) www.iitgoa.ac.in
b) www.iceland.is

5. Read up about the `traceroute` command. You can view its manual by typing `man traceroute` in the Linux terminal. Get a broad idea of what this command does, how it

works and how to interpret its output. (Note the "-m" option in traceroute, which you may need to tweak in order to get proper results. Also note the difference between `traceroute -I`, `traceroute -T` and `traceroute -U`)

Briefly explain (in 4-5 sentences) how traceroute works, by utilizing the TTL field in the Network-layer header.

6. Consider a country located far away geographically from India. Find out the url of some prominent university or public website hosted in that country. We wish to check if the webserver for this site is indeed located physically in that country, and trace the route that our packets take to reach this webserver.

   a) Find out the IP address of this webserver using online tools such as 'ipinfo.io' and commands such as 'dig'.

   b) Use traceroute command to trace the path followed by packets flowing from your computer to this webserver. How many total hops were taken to reach the destination ?

   c) Some hops may not be shown (appearing as * * * in the output of the traceroute command. What do these lines mean?

   d) Traceroute does 3 trials (sends 3 messages) to each hop by default. What is the command to get traceroute to do 5 trials instead?

   e) What is the average round-trip delay (in mili-seconds) for reaching the final destination?

   f) Use online services such as "ipinfo.io" to find and list the geographical location (City, State, Country) where the last hop is located.

   g) Use online tools such as the Traceroot mapper (https://stefansundin.github.io/traceroute-mapper/) to visualize the hops taken by your packets on a 3D map.

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