Lab 4

(Due your class day Oct 16/17/18/5)

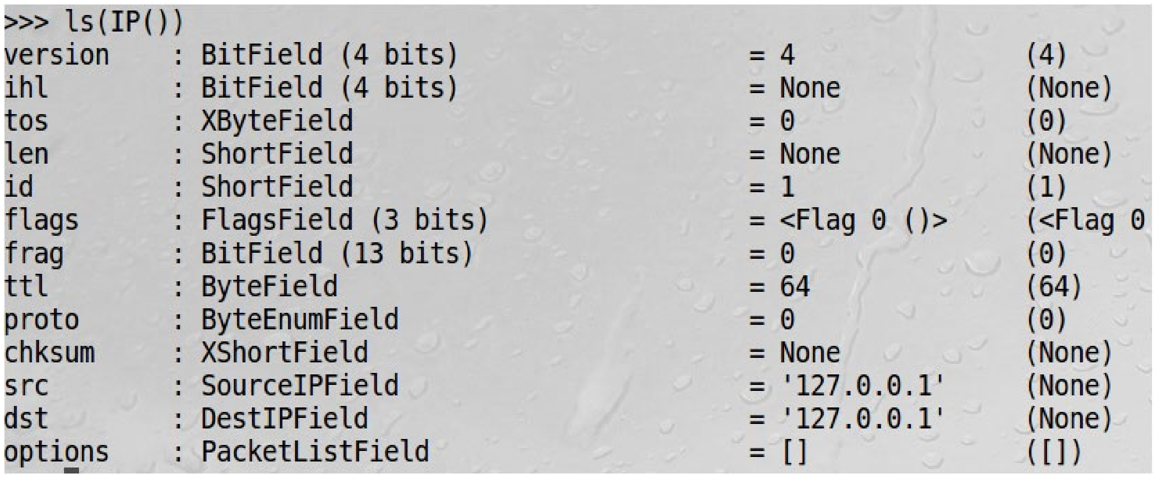
1. Packet Construction with Scapy

In this exercise, you will practice to construct several packets using scapy. To start, run $sudo python3 (if you work on VM root, sudo is not needed) and then import scapy package:

from scapy.all import *

Then, you are ready to practice constructing various packets. In each question, show your screen shots as the evidence of your work.

1) IP() is the function to construct a default IP header. You can use ls(IP()) to view the content. The first column is the field of IP header and the third column is the example format for the value of each field.



```
>>> ls(IP())
version    : BitField (4 bits)                    = 4            (4)
ihl        : BitField (4 bits)                    = None         (None)
tos        : XByteField                           = 0            (0)
len        : ShortField                           = None         (None)
id         : ShortField                           = 1            (1)
flags      : FlagsField (3 bits)                  = <Flag 0 ()>  (<Flag 0
frag       : BitField (13 bits)                   = 0            (0)
ttl        : ByteField                            = 64           (64)
proto      : ByteEnumField                        = 0            (0)
chksum     : XShortField                          = None         (None)
src        : SourceIPField                        = '127.0.0.1'  (None)
dst        : DestIPField                          = '127.0.0.1'  (None)
options    : PacketListField                      = []           ([])
```

You can assign the value to create the IP header you want. Please construct an ip header **iph** with source 10.0.2.4 and destination 10.10.10.10. Use ls to show packet header.

2) Create a UDP **segment** with source port number 5000 and destination port number 5300 and data="hello". Use show2 to show your result.

3) You can create ping packet by stacking IP header over ICMP(). Create a ping packet with your VM as source IP and 10.10.10.10 as your destination IP. Create an ip packet with the same source and destination IP (as in the ping packet) but with UDP segment in item 2 as its data field. Use show2() function to show the packet content.

4) For a packet pkt, pkt[IP] is IP datagram and pkt[UDP] is the UDP segment of pkt. For ip datagram in item 3, use show2 to show the UDP segment.

2. Sniffing Packets

Wireshark is the most popular sniffing tool, and it is easy to use. We will use it throughout the entire lab. The objective of the current task is to learn how to use Scapy to do packet sniffing in Python programs. A sample code is the following:

```
------------------------------------------------------------
#!/usr/bin/python
from scapy.all import *

def  print_pkt(pkt):
      pkt.show2()
pkt = sniff(filter='icmp',prn=print_pkt, iface="br-xxx")    # br-xxx is the interface on VM you want to sniff
------------------------------------------------------------
```

Task A. The above program sniffs packets. For each captured packet, the callback function print pkt() will be invoked; this function will print out some of the information about the packet. Run the program with the root privilege and demonstrate that you can indeed capture packets. After that, run the program again, but without using the root privilege; describe and explain your observations.

// Run the program with the root privilege
$ sudo python sniffer.py

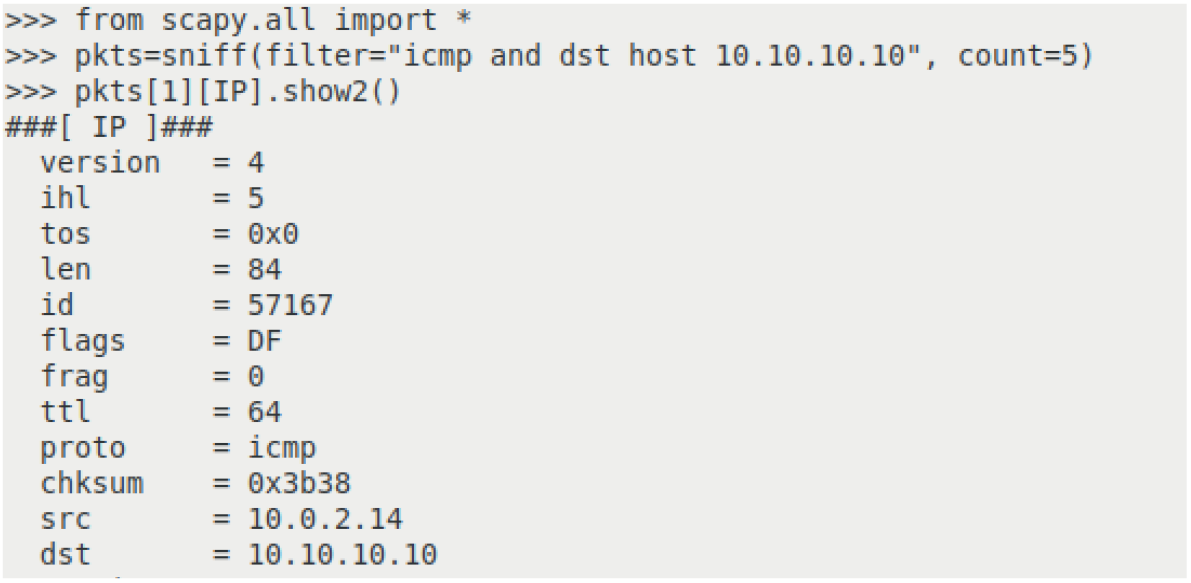
// Run the program without the root privilege
$ python sniffer.py

Task B. In this task, you need to modify the **program** to *simultaneously* achieve two goals:

1. When we sniff packets, we are only interested certain types of packets. Your program only sniffs the ICMP packet with source IP address 10.10.10.10.
2. For each captured ICMP packet, reverse the source and destination IP address and modify the ICMP data field as "COMP8677-yourname". Finally, send the modified packet.

Run your Wireshark to check if 10.10.10.10 replied to your packet sent by item 2. If yes, give a screenshot for one such packet. In this task, provide your program and the said screenshot.

Task C. In this task, you will practice more for BPF filter. You have studied one in your Task B. If necessary, check the reference file BPF.pdf. Test your solution using the sniff function on the command line of python and show one packet content. Here is my example for the test.



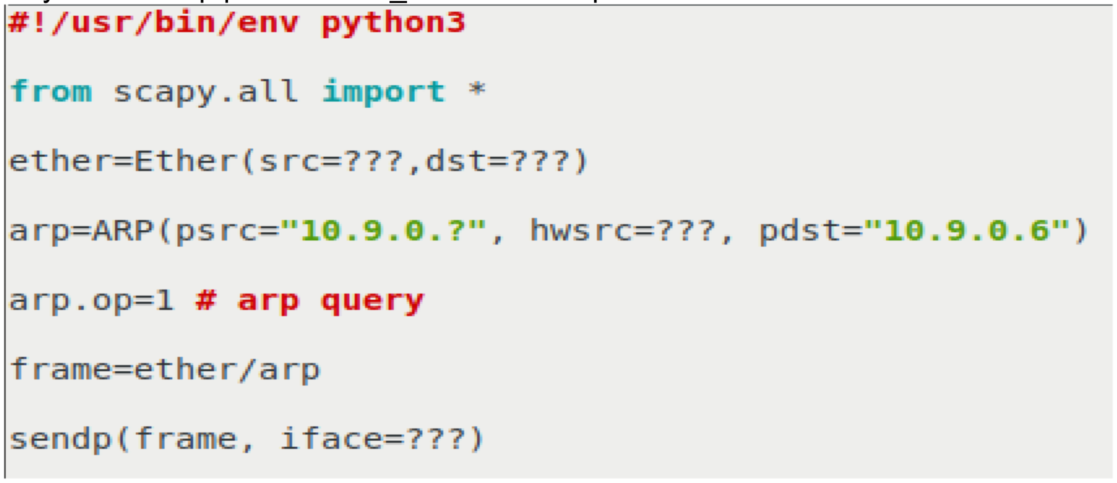
```
>>> from scapy.all import *
>>> pkts=sniff(filter="icmp and dst host 10.10.10.10", count=5)
>>> pkts[1][IP].show2()
###[ IP ]###
  version   = 4
  ihl       = 5
  tos       = 0x0
  len       = 84
  id        = 57167
  flags     = DF
  frag      = 0
  ttl       = 64
  proto     = icmp
  chksum    = 0x3b38
  src       = 10.0.2.14
  dst       = 10.10.10.10
```

a) Capture any TCP packet that comes from www.example.com with destination network being your VM subnet (mostly 10.0.2.0/24). We remind you that in order to capture packets from example.com, you of course need to visit the web site.

b) Capture packets that come from source port 53 and a **particular** network such as 10.10.10.0/24. In the test, run $dig @10.10.10.10 www.mit.edu. (note: if you do your assignment at home, you can change 10.10.10.10 to 8.8.8.8 and the subnet 8.8.0.0/16).

3. ARP Cache Poisoning Attack

When our computer needs to send a packet to another computer (such as the gateway router) in the same LAN, it will first run ARP protocol to find this computer's MAC (if it does not have this in its ARP table). In this problem, you will practice the ARP cache poisoning attack. Using docker-compose.yml, you will simulate a subnet 10.9.0.0/24, containing attacker 10.9.0.1 and users 10.9.0.5, 10.9.0.6. Let **mac_d** be the mac address of 10.9.0.**d**. Our task is to cheat 10.9.0.6 to include entry <10.9.0.5, mac_1> into its arp table. The following is the incomplete code with question marks. **Note**: ***sendp***() is similar to ***send***() but it sends a link layer frame while ***send***() only sends an ip packet. mac_d should be replaced with the actual mac address of 10.9.0.d.



```
#!/usr/bin/env python3

from scapy.all import *

ether=Ether(src=???,dst=???)

arp=ARP(psrc="10.9.0.?", hwsrc=???, pdst="10.9.0.6")

arp.op=1 # arp query

frame=ether/arp

sendp(frame, iface=???)
```

Complete the following tasks:
1. complete the above program.
   Hint: this runs ARP protocol and so it should indicate it is a broadcast frame; attack idea: if 10.9.0.6 receives an ARP query, it will record (sender IP, sender MAC) of the query frame into its ARP table.
2. run **arp** on 10.9.0.6 to see if entry (10.9.0.5, MAC_1) is included in its arp table.
3. Explain how the attack works.