

ECE 636
COMPUTER NETWORKING LABORATORY

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(Lab 5)Experiment with UDP/TCP

1. What is the original MTU of your workstation? What is the minimum value of 'NUM' which causes fragmentation? Is this value the same as MTU? Why?

The MTU is 1500 bytes. Minimum value is 14784 bytes. No, the value is less than MTU.

2. To what value did you change the MTU of your host? What is the maximum value of 'NUM' without fragmentation? Justify your result.
3. Explain how this modified traceroute program determines the path MTU.
4. Capture the related packets and decode them. How are the UDP datagrams fragmented? Do all packets have their UDP headers? How can you verify your answer from your tcpdump output?

Yes, All packets have the UDP headers. When we decode the UDP Packets every header is present and the tcpdump output consists of this information in hexadecimal.

5. Explain the operation and implementation of talk program by decoding the captured packets. Which protocol does it employ? UDP, TCP, or both? Why?

It employs UDP protocol and the implementation of the talk program is using sockets, one acting as server and the other host acting as the client. Because it is a direct connection without encryption and we

cannot see any tcp packets in the tcpdump output observed when the talk program was running.

5.2.1. Sock Program

- 1) To begin with , I ran the "**sock -v -s port#>**" command on one workstation (to act as the application server, port# which was used is 5556); at the same time, lab partner runs the "**sock -v -s port#>**" command on his workstation. After I've established a connection, the partner types some characters and presses the "**enter**" button.



The screenshot shows a terminal window with a menu bar at the top containing "Applications", "Places", and "Terminal". The title bar indicates the session is "ak2739@t3net03:~". The terminal window displays a conversation between two hosts:

```
File Edit View Search Terminal Help
t3net03-67 ~ >: sock -v -s 5554
can't bind local address: Address already in use
t3net03-68 ~ >: sock -v -s 5556
connection on 10.10.201.12.5556 from 10.10.201.13.58270
TCP MAXSEG = 1448
Hello Mr. Ayush from Hardik
Message 2 to ayush
Message 3 from Hardik
Message 1
message 2
message 3
^C
t3net03-69 ~ >: sock -v -s 5553
connection on 10.10.201.12.5553 from 10.10.201.13.40122
TCP MAXSEG = 1448
Hello Ayush from hardik
How are you?
networking lab 5
connection closed by peer
t3net03-70 ~ >: 
```

The result of the talk screen.

```

ak2739@t3net03:~
```

File Edit View Search Terminal Help

3980 packets received by filter
0 packets dropped by kernel
t3net03-46 ~ >: clear

t3net03-47 ~ >: tcpdump host 10.10.201.12 -i p1p1

tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on p1p1, link-type EN10MB (Ethernet), capture size 262144 bytes

18:45:59.526429 ARP, Request who-has t3net03 tell gateway, length 46
18:45:59.526457 ARP, Reply t3net03 is-at b4:96:91:51:cf:14 (oui Unknown), length 28
18:45:59.527803 IP t3net03.42426 > dns1.njit.edu.domain: 48736, PTR? 12.201.10.10.in-addr.arpa. (43)
18:45:59.528632 IP dns1.njit.edu.domain > t3net03.42426: 48736 NXDomain* 0/1/0 (118)
18:45:59.531373 IP t3net03.40190 > dns1.njit.edu.domain: 39544+, PTR? 1.201.10.10.in-addr.arpa. (42)
18:45:59.532034 IP dns1.njit.edu.domain > t3net03.40190: 39544 NXDomain* 0/1/0 (117)
18:45:59.532855 IP t3net03.51080 > dns1.njit.edu.domain: 30453+, PTR? 10.251.235.128.in-addr.arpa. (45)
18:45:59.533837 IP t3net03.51080 > dns1.njit.edu.domain: 30453 1/4/4 PTR dns1.njit.edu. (231)
18:46:01.311102 IP t3net04.40122 > t3net03.sgi-eventmond: Flags [S], seq 4205710991, win 29200, options [mss 1460,sackOK,TS val 19679259 ecr 0,nop,wscale 7], length 0
18:46:01.311184 IP t3net03.sgi-eventmond > t3net04.40122: Flags [S..], seq 1212985419, ack 4205710992, win 28960, options [mss 1460,sackOK,TS val 618598860 ecr 19679259,nop,wscale 7], length 0
18:46:01.311192 IP t3net04.40122 > t3net03.sgi-eventmond: Flags [.], ack 1, win 229, options [nop,nop,TS val 19679260 ecr 618598860], length 0
18:46:01.952692 ARP t3net03.afs3-callback > ucsafsinf03.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 536870916/10/4235 (44)
18:46:01.952761 IP t3net03.59700 > dns1.njit.edu.domain: 19135+, PTR? 189.203.235.128.in-addr.arpa. (46)
18:46:01.953309 IP dns1.njit.edu.domain > t3net03.59700: 19135* 1/4/4 PTR ucsafsinf03.coresys.njit.edu. (252)
18:46:01.953323 IP t3net03.sgi-eventmond > t3net03.afs3-callback: rx ack first 1 serial 0 reason ping acked 1 (66)
18:46:01.953367 IP t3net03.afs3-callback > ucsafsinf03.coresys.njit.edu.afs3-filserver: rx ack first 1 serial 1 reason ping response (65)
18:46:01.953391 IP ucsafsinf03.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx data cb call tellmeaboutyourself (32)
18:46:01.953397 IP t3net03.afs3-callback > ucsafsinf03.coresys.njit.edu.afs3-filserver: rx data (468)
18:46:01.954387 IP ucsafsinf03.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx ack first 2 serial 0 reason delay (65)
18:46:01.954563 IP ucsafsinf03.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx data (148)
18:46:01.954718 IP t3net03.afs3-callback > ucsafsinf03.coresys.njit.edu.afs3-filserver: rx ack first 2 serial 0 reason delay (65)
18:46:01.954748 IP t3net03.afs3-callback > ucsafsinf01.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 536870936/1/1 (44)
18:46:01.954812 IP t3net03.41061 > dns1.njit.edu.domain: 45517+, PTR? 211.208.235.128.in-addr.arpa. (46)
18:46:01.955275 IP ucsafsinf01.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx ack first 1 serial 0 reason ping acked 1 (66)
18:46:01.955276 IP dns1.njit.edu.domain > t3net03.41061: 45517* 1/4/4 PTR ucsafsinf01.coresys.njit.edu. (252)
18:46:01.955321 IP t3net03.afs3-callback > ucsafsinf01.coresys.njit.edu.afs3-filserver: rx ack first 1 serial 1 reason ping response (65)
18:46:01.955788 IP ucsafsinf01.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx data cb call tellmeaboutyourself (32)
18:46:01.955848 IP t3net03.afs3-callback > ucsafsinf01.coresys.njit.edu.afs3-filserver: rx data (468)
18:46:01.956342 IP ucsafsinf01.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx ack first 2 serial 0 reason delay (65)
18:46:01.956348 IP ucsafsinf01.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx data (148)
18:46:01.956397 IP t3net03.afs3-callback > ucsafsinf01.coresys.njit.edu.afs3-filserver: rx ack first 2 serial 0 reason delay (65)
18:46:01.956429 IP t3net03.afs3-callback > ucsafsinf01.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 536870936/36/926760 (44)
18:46:01.956891 IP ucsafsinf01.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx data (148)
18:46:01.956943 IP t3net03.afs3-callback > ucsafsinf01.coresys.njit.edu.afs3-filserver: rx ack first 2 serial 0 reason delay (65)
18:46:01.956971 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 537646343/1/1 (44)
18:46:01.957024 IP t3net03.34493 > dns1.njit.edu.domain: 672+, PTR? 208.235.128.in-addr.arpa. (46)
18:46:01.957519 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx ack first 1 serial 0 reason ping acked 1 (66)
18:46:01.957534 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx ack first 1 serial 1 reason ping response (65)
18:46:01.957598 IP dns1.njit.edu.domain > t3net03.34493: 672* 1/4/4 PTR ucsafblk04.coresys.njit.edu. (252)
18:46:01.958061 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx data cb call tellmeaboutyourself (32)
18:46:01.958118 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data (468)
18:46:01.958621 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx ack first 2 serial 0 reason delay (65)
18:46:01.958704 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx data (148)
18:46:01.958732 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx ack first 2 serial 0 reason delay (65)
18:46:01.958756 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 537646343/23/17440 (44)

18:46:01.958756 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 537646343/23/17440 (44)
18:46:01.959254 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx data (148)
18:46:01.959333 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx ack first 2 serial 0 reason delay (65)
18:46:01.959358 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 537646343/2834/17607 (44)
18:46:01.959943 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx abort (32)
18:46:01.960050 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 537646343/2834/17607 (44)
18:46:01.960494 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx abort (32)
18:46:01.961133 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 537646343/2834/17607 (44)
18:46:01.961590 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx abort (32)
18:46:01.961665 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 537646343/2834/17607 (44)
18:46:01.962128 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx abort (32)
18:46:01.962622 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 537646343/2834/17607 (44)
18:46:01.963053 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx abort (32)
18:46:01.963096 IP t3net03.afs3-callback > ucsafblk04.coresys.njit.edu.afs3-filserver: rx data fs call fetch-status fid 537646343/2834/17607 (44)
18:46:01.963548 IP ucsafblk04.coresys.njit.edu.afs3-filserver > t3net03.afs3-callback: rx abort (32)
18:46:06.322294 ARP, Request who-has t3net04 tell t3net03, length 28
18:46:06.322885 ARP, Reply t3net04 is-at b4:96:91:52:32:28 (oui Unknown), length 46
18:46:09.307573 IP t3net04.40122 > t3net03.sgi-eventmond: Flags [P..], seq 1:25, ack 1, win 229, options [nop,nop,TS val 19687256 ecr 618598860], length 24
18:46:09.307632 IP t3net03.sgi-eventmond > t3net04.40122: Flags [.], ack 25, win 227, options [nop,nop,TS val 618606857 ecr 19687256], length 0
18:46:09.554321 IP t3net03.vacdsm-app > t3net.nfs: Flags [P..], ack 3361538562, win 1424, options [nop,nop,TS val 618607104 ecr 4108716294], length 0
18:46:09.554453 IP t3net03.vacdsm-app > t3net.nfs: Flags [P..], seq 1:21, ack 1, win 1424, options [nop,nop,TS val 618607104 ecr 4108716294], length 120: NFS request xid 3265021318 116 getattr fh 0,1/53
18:46:09.554648 IP t3net.nfs > t3net03.vacdsm-app: Flags [.], ack 1, win 1432, options [nop,nop,TS val 4108776454 ecr 618546944], length 0
18:46:09.554682 IP t3net.nfs > t3net03.vacdsm-app: Flags [P..], seq 1:85, ack 121, win 1432, options [nop,nop,TS val 4108776454 ecr 618607104], length 84: NFS reply xid 3265021318 reply ok 80 getattr NON 1 ids 0/815326306 sz 1448624223
18:46:09.554711 IP t3net03.vacdsm-app > t3net.nfs: Flags [.], ack 85, win 1424, options [nop,nop,TS val 618607104 ecr 4108776454], length 0
18:46:12.134603 IP t3net03.afs3-callback > ucsafsinf03.coresys.njit.edu.afs3-filserver: rx version (29)
18:46:13.658974 IP t3net04.40122 > t3net03.sgi-eventmond: Flags [P..], seq 25:39, ack 1, win 229, options [nop,nop,TS val 19691607 ecr 618606857], length 14
18:46:13.659023 IP t3net03.sgi-eventmond > t3net04.40122: Flags [.], ack 39, win 227, options [nop,nop,TS val 618611208 ecr 19691607], length 0
18:46:14.562547 ARP, Request who-has t3net tell t3net03, length 28
18:46:14.563006 ARP, Reply t3net is-at 00:e0:4c:a0:40:(oui Unknown), length 46
18:46:23.579786 IP t3net04.40122 > t3net03.sgi-eventmond: Flags [P..], seq 39:56, ack 1, win 229, options [nop,nop,TS val 19701528 ecr 618611208], length 17
18:46:23.579842 IP t3net03.sgi-eventmond > t3net04.40122: Flags [.], ack 56, win 227, options [nop,nop,TS val 618621129 ecr 19701528], length 0

C
75 packets captured
75 packets received by filter
0 packets dropped by kernel
t3net03-48 ~ >:

TCP dump output captured when the sock command was running in the other terminal.

- 2) Running the command `sock -u -s 7772` where 7772 is any unused port number.

```
t3net03-71 ~ >: sock -u -s 7772
```

The result of `netstat -a -n` on another terminal. The netstat table consists of various tcp and udp connections. The one sock connection established for udp is marked in the `netstat -a -n` table.

`-u` means urgent mode. 1 byte of data is written. `-s` with udp specifies the largest datagram that can be sent.

```
t3net03-49 ~ >: netstat -a -n
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address          Foreign Address        State
tcp     0      0 192.168.122.1:53        0.0.0.0:*
tcp     0      0 0.0.0.0:22            0.0.0.0:*
tcp     0      0 127.0.0.1:631         0.0.0.0:*
tcp     0      0 127.0.0.1:25         0.0.0.0:*
tcp     0      0 0.0.0.0:111          0.0.0.0:*
tcp     0      0 10.10.201.12:671       10.10.201.3:2049    ESTABLISHED
tcp     0      0 10.10.201.12:55294       128.235.208.172:389  ESTABLISHED
tcp6    0      0 :::22                  :::*
tcp6    0      0 ::1:631                :::*
tcp6    0      0 ::1:25                 :::*
tcp6    0      0 ::1:111                :::*
udp     0      0 0.0.0.0:5353         0.0.0.0:*
udp     0      0 0.0.0.0:46427        0.0.0.0:*
udp     0      0 0.0.0.0:7001         0.0.0.0:*
udp     0      0 0.0.0.0:7772         0.0.0.0:*
```

0	0.0.0.0:7772	0.0.0.0:*
---	--------------	-----------

```
udp     0      0 192.168.122.1:53        0.0.0.0:*
udp     0      0 0.0.0.0:67            0.0.0.0:*
udp     0      0 0.0.0.0:111          0.0.0.0:*
udp     0      0 127.0.0.1:323         0.0.0.0:*
udp6    0      0 :::111                :::*
udp6    0      0 ::1:323                :::*
raw6   0      0 ::::58                :::*
raw6   0      0 ::::58                :::*
```

7	7
---	---

```
Active UNIX domain sockets (servers and established)
Proto RefCnt Flags     Type      State         I-Node  Path
unix  2      [ ACC ]   STREAM   LISTENING    25028   public/qmgr
unix  2      [ ACC ]   STREAM   LISTENING    25050   public/flush
unix  2      [ ACC ]   STREAM   LISTENING    23921   /var/lib/sss/pipes/private/pam
```

3)

```
t3net03-54 ~ >: sock -u -s 127.0.0.1 9923
```

```
t3net03-74 ~ >: sock -u -s 9931
```

Commands used on 2 different terminals after which netstat -a -n has been observed.

```
t3net03-41 ~ >: netstat -a -n
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address          Foreign Address        State
tcp      0      0 192.168.122.1:53        0.0.0.0:*
tcp      0      0 0.0.0.0:22        0.0.0.0:*
tcp      0      0 127.0.0.1:631        0.0.0.0:*
tcp      0      0 127.0.0.1:25        0.0.0.0:*
tcp      0      0 0.0.0.0:111       0.0.0.0:*
tcp      0      0 10.10.201.12:671       10.10.201.3:2049    ESTABLISHED
tcp      0      0 10.10.201.12:55386      128.235.251.109:389  ESTABLISHED
tcp      0      0 10.10.201.12:56096      128.235.251.51:389  ESTABLISHED
tcp6     0      0 :::22                  :::*
tcp6     0      0 ::1:631                :::*
tcp6     0      0 ::1:25                :::*
tcp6     0      0 ::1:111               :::*
udp      0      0 0.0.0.0:5353       0.0.0.0:*
udp      0      0 0.0.0.0:46427      0.0.0.0:*
udp      0      0 0.0.0.0:7001       0.0.0.0:*
udp      0      0 192.168.122.1:53      0.0.0.0:*
udp      0      0 0.0.0.0:67         0.0.0.0:*
udp      0      0 0.0.0.0:111        0.0.0.0:*
udp      0      0 127.0.0.1:323       0.0.0.0:*
udp      0      0 127.0.0.1:9923       0.0.0.0:*
udp      0      0 0.0.0.0:9931       0.0.0.0:*
tcp6     0      0 :::111               :::*
tcp6     0      0 ::1:323              :::*
raw6    0      0 ::::58              ::::*
raw6    0      0 ::::58              ::::*
```

The netstat - a - n table consists of the new sockets added at 127.0.0.1: 9923 which is the port number and 0.0.0.0 : 9931 which is the port number for the second command. 127.0.0.1 refers to the loopback address and 0.0.0.0 refers to the default gateway address to the internet.

3)

```
t3net03-41 ~ >: sock -u -s 8864
```

```
t3net03-41 ~ >: sock -u -A 127.0.0.1 8878
```

```
t3net03-41 ~ >: sock -u -A 10.10.201.12 8881
```

```
t3net03-41 ~ >: netstat -a -n
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address          Foreign Address        State
tcp     0      0 192.168.122.1:53        0.0.0.0:*
tcp     0      0 0.0.0.0:22        0.0.0.0:*
tcp     0      0 127.0.0.1:631       0.0.0.0:*
tcp     0      0 127.0.0.1:25       0.0.0.0:*
tcp     0      0 0.0.0.0:111       0.0.0.0:*
tcp     0      0 10.10.201.12:671      10.10.201.3:2049    ESTABLISHED
tcp     0      0 10.10.201.12:58128     128.235.205.72:389  ESTABLISHED
tcp6    0      0 :::22                  :::*
tcp6    0      0 ::1:631                :::*
tcp6    0      0 ::1:25                :::*
tcp6    0      0 ::::111               :::*
udp     0      0 0.0.0.0:5353       0.0.0.0:*
udp     0      0 0.0.0.0:46427      0.0.0.0:*
udp     0      0 0.0.0.0:7001       0.0.0.0:*
udp     0      0 127.0.0.1:56484     127.0.0.1:8878      ESTABLISHED
udp     0      0 192.168.122.1:53      0.0.0.0:*
udp     0      0 0.0.0.0:67         0.0.0.0:*
udp     0      0 0.0.0.0:111        0.0.0.0:*
udp     0      0 127.0.0.1:323        0.0.0.0:*
udp     0      0 0.0.0.0:8864       0.0.0.0:*
udp     0      0 10.10.201.12:50023     10.10.201.12:8881    ESTABLISHED
udp6   0      0 :::111               :::*
udp6   0      0 ::1:323               :::*
raw6   0      0 ::::58              :::*
raw6   0      0 ::::58              :::*
```

Netstat -a -n output for the issued commands in the other terminal

The commands show the socket 8864 in the entry 0.0.0.0 : 8864 with the default internet gateway address and the entry for port 8878 is in the foreign address section and the connection between 56864 port and 8878 port is established. Similarly for the port 8881 for ip address 10.10.201.12 is established with the port 50023.

4) and 5)

```
t3net03-41 ~ >: sock -u -s 8864
```

-u means urgent mode. 1 byte of data is written. -s with udp specifies the largest datagram that can be sent.

The screenshot shows a terminal window with the following details:

- Top Bar:** Applications, Places, Terminal
- Right Top Corner:** ak2739@t3net03:~/Pictures/Lab 5/5.2.1
- Terminal Content:**

```
t3net03-41 5.2.1 >: sock -help
usage: sock [ options ] <host> <port>          (for client; default)
       sock [ options ] -s [ <IPaddr> ] <port>      (for server)
       sock [ options ] -i <host> <port>            (for "source" client)
       sock [ options ] -i -s [ <IPaddr> ] <port>    (for "sink" server)
options: -b n bind n as client's local port number
         -c convert newline to CR/LF & vice versa
         -f a.b.c.d.p foreign IP address = a.b.c.d, foreign port# = p
         -g a.b.c.d loose source route
         -h issue TCP half close on standard input EOF
         -i "source" data to socket, "sink" data from socket (w/-s)
         -j a.b.c.d join multicast group
         -k write or writev in chunks
         -l a.b.c.d.p client's local IP address = a.b.c.d, local port# = p
         -n n #buffers to write for "source" client (default 1024)
         -o do NOT connect UDP client
         -p n #ms to pause before each read or write (source/sink)
         -q n size of listen queue for TCP server (default 5)
         -r n #bytes per read() for "sink" server (default 1024)
         -s operate as server instead of client
         -t n set multicast ttl
         -u use UDP instead of TCP
         -v verbose
         -w n #bytes per write() for "source" client (default 1024)
         -x n #ms for SO_RCVTIMEO (receive timeout)
         -y n #ms for SO_SNDTIMEO (send timeout)
         -A SO_REUSEADDR option
         -B SO_BROADCAST option
         -C set terminal to cbreak mode
         -D SO_DEBUG option
         -E IP_RECVSIG option
         -F fork after connection accepted (TCP concurrent server)
         -G a.b.c.d strict source route
         -H n IP_TOS option (16=min del, 8=max thru, 4=max rel, 2=min$)
         -I SIGIO signal
         -J n IP_TTL option
         -K SO_KEEPALIVE option
         -L n SO_LINGER option, n = linger time
         -N TCP_NODELAY option
         -O n #ms to pause after listen, but before first accept
         -P n #ms to pause before first read or write (source/sink)
         -Q n #ms to pause after receiving FIN, but before close
         -R n SO_RCVBUF option
         -S n SO_SNDBUF option
         -U n enter urgent mode before write number n (source only)
         -V use writev() instead of write(); enables -k too
         -W ignore write errors for sink client
         -X n TCP_MAXSEG option (set MSS)
         -Y SO_DONTROUTE option
         -Z MSG_PEEK
```

5.2.2.

- 1) Ifconfig shows the mtu of all of the interfaces in the workstation.
The mtu's in the figure have been marked and all the mtu's have a value of 1500 bytes.

ak2739@t3net03:~

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To see your aliases, enter "alias"

```
t3net03-41 ~ >: ifconfig
em1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.10.100.12 netmask 255.255.255.0 broadcast 10.10.100.255
        inet6 fe80::f6dc:5d61:b8fd:6470 prefixlen 64 scopeid 0x20<link>
            ether 6c:2b:59:e3:3a:a1 txqueuelen 1000 (Ethernet)
            RX packets 360 bytes 45957 (44.8 KiB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 214 bytes 27165 (26.5 KiB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
            device interrupt 16 memory 0xa5c00000-a5c20000

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
        inet6 ::1 prefixlen 128 scopeid 0x10<host>
            loop txqueuelen 1000 (Local Loopback)
            RX packets 62 bytes 5308 (5.1 KiB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 62 bytes 5308 (5.1 KiB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

plp1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.10.201.12 netmask 255.255.255.0 broadcast 10.10.201.255
        inet6 fe80::b696:91ff:fe51:cf14 prefixlen 64 scopeid 0x20<link>
            ether b4:96:91:51:cf:14 txqueuelen 1000 (Ethernet)
            RX packets 967851 bytes 747741184 (713.1 MiB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 1070887 bytes 815364325 (777.5 MiB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
            device memory 0xa5300000-a53fffff

virbr0: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
    inet 192.168.122.1 netmask 255.255.255.0 broadcast 192.168.122.255
        ether 52:54:00:d5:b6:13 txqueuelen 1000 (Ethernet)
        RX packets 0 bytes 0 (0.0 B)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 0 bytes 0 (0.0 B)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

t3net03-42 ~ >: □
```

2)

Applications Places Terminal

ak2739@t3net03:~

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```
t3net03-47 ~ >: tcpdump host 10.10.201.12 and not broadcast and not host 128.235 -vn -i plp1
tcpdump: listening on plp1, link-type EN10MB (Ethernet), capture size 262144 bytes
18:17:25.642686 IP (tos 0x0, ttl 64, id 44132, offset 0, flags [+], proto UDP (17), length 1500)
    10.10.201.12.45359 > 10.10.201.13.discard: UDP, bad length 6000 > 1472
18:17:25.642699 IP (tos 0x0, ttl 64, id 44132, offset 1480, flags [+], proto UDP (17), length 1500)
    10.10.201.12 > 10.10.201.13: ip-proto-17
18:17:25.642848 IP (tos 0x0, ttl 64, id 44132, offset 2960, flags [+], proto UDP (17), length 1500)
    10.10.201.12 > 10.10.201.13: ip-proto-17
18:17:25.642859 IP (tos 0x0, ttl 64, id 44132, offset 4440, flags [+], proto UDP (17), length 1500)
    10.10.201.12 > 10.10.201.13: ip-proto-17
18:17:25.642862 IP (tos 0x0, ttl 64, id 44132, offset 5920, flags [none], proto UDP (17), length 108)
    10.10.201.12 > 10.10.201.13: ip-proto-17
18:17:25.643099 IP (tos 0xc0, ttl 64, id 53937, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.13 > 10.10.201.12: ICMP host 10.10.201.13 unreachable - admin prohibited, length 556
        IP (tos 0x0, ttl 64, id 44132, offset 0, flags [none], proto UDP (17), length 6028)
    10.10.201.12.45359 > 10.10.201.13.discard: UDP, length 6000
18:17:30.658367 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.13 tell 10.10.201.12, length 28
18:17:30.658996 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.13 is-at b4:96:91:52:32:2e, length 46
□
```

```
t3net03-43 ~ >: sock -v -u -i -n1 -w6000 10.10.201.13 discard
connected on 10.10.201.12.45359 to 10.10.201.13.9
wrote 6000 bytes
```

3) At the NUM value of 1473 bytes the packet was first fragmented.

```
t3net03-42 ~ >: tcpdump host 10.10.201.12 and not broadcast and not host 128.235 -vn -i plp1
tcpdump: listening on plp1, link-type EN10MB (Ethernet), capture size 262144 bytes
19:38:20.149752 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.12 tell 10.10.201.1, length 46
19:38:20.149786 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.12 is-at b4:96:91:51:cf:14, length 28
19:38:26.358450 IP (tos 0x0, ttl 64, id 45894, offset 0, flags [DF], proto UDP (17), length 1498)
    10.10.201.12.40472 > 10.10.201.13.discard: UDP, length 1470
19:38:26.359098 IP (tos 0xc0, ttl 64, id 7911, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.13 > 10.10.201.12: ICMP host 10.10.201.13 unreachable - admin prohibited, length 556
        IP (tos 0x0, ttl 64, id 45894, offset 0, flags [DF], proto UDP (17), length 1498)
    10.10.201.12.40472 > 10.10.201.13.discard: UDP, length 1470
19:38:31.222068 IP (tos 0x0, ttl 64, id 47653, offset 0, flags [DF], proto UDP (17), length 1499)
    10.10.201.12.50264 > 10.10.201.13.discard: UDP, length 1471
19:38:31.222456 IP (tos 0xc0, ttl 64, id 10193, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.13 > 10.10.201.12: ICMP host 10.10.201.13 unreachable - admin prohibited, length 556
        IP (tos 0x0, ttl 64, id 47653, offset 0, flags [DF], proto UDP (17), length 1499)
    10.10.201.12.50264 > 10.10.201.13.discard: UDP, length 1471
19:38:31.363472 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.12 tell 10.10.201.13, length 46
19:38:31.363484 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.12 is-at b4:96:91:51:cf:14, length 28
19:38:33.531388 IP (tos 0x0, ttl 64, id 7748, offset 0, flags [DF], proto UDP (17), length 1498)
    10.10.201.13.60381 > 10.10.201.12.discard: UDP, length 1470
19:38:33.531478 IP (tos 0xc0, ttl 64, id 63500, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.12 > 10.10.201.13: ICMP 10.10.201.12 udp port discard unreachable, length 556
        IP (tos 0x0, ttl 64, id 7748, offset 0, flags [DF], proto UDP (17), length 1498)
    10.10.201.13.60381 > 10.10.201.12.discard: UDP, length 1470
19:38:35.830297 IP (tos 0x0, ttl 64, id 48355, offset 0, flags [DF], proto UDP (17), length 1500)
    10.10.201.12.34598 > 10.10.201.13.discard: UDP, length 1472
19:38:35.830960 IP (tos 0xc0, ttl 64, id 11244, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.13 > 10.10.201.12: ICMP host 10.10.201.13 unreachable - admin prohibited, length 556
        IP (tos 0x0, ttl 64, id 48355, offset 0, flags [DF], proto UDP (17), length 1500)
    10.10.201.12.34598 > 10.10.201.13.discard: UDP, length 1472
19:38:39.174374 IP (tos 0x0, ttl 64, id 51517, offset 0, flags [+], proto UDP (17), length 1500)
    10.10.201.12.43334 > 10.10.201.13.discard: UDP, bad length 1473 > 1472
19:38:39.174388 IP (tos 0x0, ttl 64, id 51517, offset 1480, flags [none], proto UDP (17), length 21)
    10.10.201.12 > 10.10.201.13: ip-proto-17
19:38:39.174753 IP (tos 0xc0, ttl 64, id 14521, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.13 > 10.10.201.12: ICMP host 10.10.201.13 unreachable - admin prohibited, length 556
        IP (tos 0x0, ttl 64, id 51517, offset 0, flags [none], proto UDP (17), length 1501)
    10.10.201.12.43334 > 10.10.201.13.discard: UDP, length 1473
```

```

19:38:40.834451 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.13 tell 10.10.201.12, length 28
19:38:40.834762 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.13 is-at b4:96:91:52:32:2e, length 46
19:38:52.002290 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.1 tell 10.10.201.12, length 28
19:38:52.002569 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.1 is-at 78:8a:20:ba:1a:de, length 46
19:38:53.707893 IP (tos 0x0, ttl 64, id 15911, offset 0, flags [DF], proto UDP (17), length 1499)
    10.10.201.13.48079 > 10.10.201.12.discard: UDP, length 1471
19:38:53.707968 IP (tos 0xc0, ttl 64, id 11574, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.12 > 10.10.201.13: ICMP 10.10.201.12 udp port discard unreachable, length 556
        IP (tos 0x0, ttl 64, id 15911, offset 0, flags [DF], proto UDP (17), length 1499)
            10.10.201.13.48079 > 10.10.201.12.discard: UDP, length 1471
19:39:08.306330 IP (tos 0x0, ttl 64, id 56468, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [.], cksum 0xa64a (incorrect -> 0xb113), ack 3361543346, win 1424, options [nop,nop,T5 val 621785856 ecr 4111895046], length 0
19:39:08.306415 IP (tos 0x0, ttl 64, id 56469, offset 0, flags [DF], proto TCP (6), length 172)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [.], cksum 0xa6c2 (incorrect -> 0x46d3), seq 1:121, ack 1, win 1424, options [nop,nop,T5 val 621785856 ecr 4111895046], length 120: NFS request xid 417099098
2 116 getattt fr 0,1/53
19:39:08.306778 IP (tos 0x0, ttl 64, id 56130, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.3.nfs > 10.10.201.12.vacdsm-app: Flags [.], cksum 0xb20a (correct), ack 1, win 1432, options [nop,nop,T5 val 4111955206 ecr 621725696], length 0
19:39:08.306809 IP (tos 0x0, ttl 64, id 56131, offset 0, flags [DF], proto TCP (6), length 136)
    10.10.201.3.nfs > 10.10.201.12.vacdsm-app: Flags [.], cksum 0x727d (correct), seq 1:85, ack 121, win 1432, options [nop,nop,T5 val 4111955206 ecr 621785856], length 84: NFS reply xid 4170990982 reply ok 80
getattt NON 1 ids 0/815326306 sz 1448624223
19:39:08.306839 IP (tos 0x0, ttl 64, id 56470, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [.], cksum 0xa64a (incorrect -> 0x3f45), ack 85, win 1424, options [nop,nop,T5 val 621785856 ecr 4111955206], length 0
19:39:13.314298 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.3 tell 10.10.201.12, length 28
19:39:13.314770 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.3 is-at 00:e0:4c:a0:40:ca, length 46
19:39:14.475807 IP (tos 0x0, ttl 64, id 33705, offset 0, flags [DF], proto UDP (17), length 1500)
    10.10.201.13.34930 > 10.10.201.12.discard: UDP, length 1472
19:39:14.475880 IP (tos 0xc0, ttl 64, id 20969, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.12 > 10.10.201.13: ICMP 10.10.201.12 udp port discard unreachable, length 556
        IP (tos 0x0, ttl 64, id 33705, offset 0, flags [DF], proto UDP (17), length 1500)
    10.10.201.13.34930 > 10.10.201.12.discard: UDP, length 1472
19:39:19.491238 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.13 tell 10.10.201.13, length 46
19:39:19.491264 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.12 is-at b4:96:91:51:c1:14, length 28
19:39:38.069853 IP (tos 0x0, ttl 64, id 32560, offset 0, flags [+], proto UDP (17), length 1500)
    10.10.201.12.49785 > 10.10.201.13.discard: UDP, bad length 1474 > 1472
19:39:38.069867 IP (tos 0x0, ttl 64, id 32560, offset 1480, flags [none], proto UDP (17), length 22)
    10.10.201.12 > 10.10.201.13: ipproto-17
19:39:38.070404 IP (tos 0xc0, ttl 64, id 53532, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.13 > 10.10.201.12: ICMP host 10.10.201.13 unreachable - admin prohibited, length 556
        IP (tos 0x0, ttl 64, id 32560, offset 0, flags [none], proto UDP (17), length 1502)

```

The highlighted part shows the message 1473>1472 bad length at which the packet was first fragmented.

```

ak2739@t3net03:~
```

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```

getaddr NON 1 ids 0/815326306 sz 1448624223
19:39:08.306839 IP (tos 0x0, ttl 64, id 56470, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [.], cksum 0xa64a (incorrect -> 0x3f45), ack 85, win 1424, options [nop,nop,TS val 621785856 ecr 4111955206], length 0
19:39:13.314298 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.3 tell 10.10.201.12, length 28
19:39:13.314770 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.3 is-at 00:e0:4c:a0:40:ca, length 46
19:39:14.475807 IP (tos 0x0, ttl 64, id 33705, offset 0, flags [DF], proto UDP (17), length 1500)
    10.10.201.13.34930 > 10.10.201.12.discard: UDP, length 1472
19:39:14.475880 IP (tos 0x0, ttl 64, id 20969, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.12 > 10.10.201.13: ICMP 10.10.201.12 udp port discard unreachable, length 556
        IP (tos 0x0, ttl 64, id 33705, offset 0, flags [DF], proto UDP (17), length 1500)
    10.10.201.13.34930 > 10.10.201.12.discard: UDP, length 1472
19:39:19.491238 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.12 tell 10.10.201.13, length 46
19:39:19.491264 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.12 is-at b4:96:91:51:c1:14, length 28
19:39:38.069853 IP (tos 0x0, ttl 64, id 32560, offset 0, flags [+], proto UDP (17), length 1500)
    10.10.201.12.49785 > 10.10.201.13.discard: UDP, bad length 1474 > 1472
19:39:38.069867 IP (tos 0x0, ttl 64, id 32560, offset 1480, flags [none], proto UDP (17), length 22)
    10.10.201.12 > 10.10.201.13: ip-proto-17
19:39:38.070404 IP (tos 0x0, ttl 64, id 53532, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.13 > 10.10.201.12: ICMP host 10.10.201.13 unreachable - admin prohibited, length 556
        IP (tos 0x0, ttl 64, id 32560, offset 0, flags [none], proto UDP (17), length 1502)
    10.10.201.12.49785 > 10.10.201.13.discard: UDP, length 1474
19:39:41.498662 IP (tos 0x0, ttl 64, id 44971, offset 0, flags [+], proto UDP (17), length 1500)
    10.10.201.13.34237 > 10.10.201.12.discard: UDP, bad length 1473 > 1472
19:39:41.498683 IP (tos 0x0, ttl 64, id 44971, offset 1480, flags [none], proto UDP (17), length 21)
    10.10.201.13 > 10.10.201.12: ip-proto-17
19:39:41.498760 IP (tos 0x0, ttl 64, id 47433, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.12 > 10.10.201.13.discard: UDP, length 1474
19:39:43.074561 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.13 is-at b4:96:91:52:32:2e, length 46
19:39:43.554287 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.1 tell 10.10.201.12, length 28
19:39:43.554641 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.1 is-at 78:8a:20:ba:1a:de, length 46
19:40:08.466489 IP (tos 0x0, ttl 64, id 56471, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [.], cksum 0xa64a (incorrect -> 0x5445), ack 85, win 1424, options [nop,nop,TS val 621846016 ecr 4111955206], length 0
19:40:08.466637 IP (tos 0x0, ttl 64, id 56472, offset 0, flags [DF], proto TCP (6), length 172)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [P..], cksum 0xa6c2 (incorrect -> 0x6ec8), seq 121:241, ack 85, win 1424, options [nop,nop,TS val 621846016 ecr 4111955206], length 120: NFS request xid 418776
8198 116 getaddr fl 0/153
19:40:08.466963 IP (tos 0x0, ttl 64, id 56132, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.3.nfs > 10.10.201.12.vacdsm-app: Flags [.], cksum 0x543c (correct), ack 121, win 1432, options [nop,nop,TS val 4112015366 ecr 621785856], length 0
19:40:08.466998 IP (tos 0x0, ttl 64, id 56133, offset 0, flags [DF], proto TCP (6), length 136)
    10.10.201.3.nfs > 10.10.201.12.vacdsm-app: Flags [P..], cksum 0x9aae (correct), seq 85:169, ack 241, win 1432, options [nop,nop,TS val 4112015366 ecr 621846016], length 84: NFS reply xid 418776198 reply ok 8
0 getaddr NON 1 ids 0/815326306 sz 1448624223
19:40:08.467030 IP (tos 0x0, ttl 64, id 56473, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [.], cksum 0xa64a (incorrect -> 0x6877), ack 169, win 1424, options [nop,nop,TS val 621846016 ecr 4112015366], length 0
19:40:13.474495 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.3 tell 10.10.201.12, length 28
19:40:13.474952 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.3 is-at 00:e0:4c:a0:40:ca, length 46
19:40:24.181617 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.12 tell 10.10.201.1, length 46
19:40:24.181651 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.12 is-at b4:96:91:51:c1:14, length 28
19:40:38.274557 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.1 tell 10.10.201.12, length 28
19:40:38.274890 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.1 is-at 78:8a:20:ba:1a:de, length 46

10.10.201.13 > 10.10.201.12: ICMP host 10.10.201.13 unreachable - admin prohibited, length 556
    IP (tos 0x0, ttl 64, id 32560, offset 0, flags [none], proto UDP (17), length 1502)
    10.10.201.12.49785 > 10.10.201.13.discard: UDP, length 1474
19:39:41.498662 IP (tos 0x0, ttl 64, id 44971, offset 0, flags [+], proto UDP (17), length 1500)
    10.10.201.13.34237 > 10.10.201.12.discard: UDP, bad length 1473 > 1472
19:39:41.498683 IP (tos 0x0, ttl 64, id 44971, offset 1480, flags [none], proto UDP (17), length 21)
    10.10.201.13 > 10.10.201.12: ip-proto-17
19:39:41.498760 IP (tos 0xc0, ttl 64, id 47433, offset 0, flags [none], proto ICMP (1), length 576)
    10.10.201.12 > 10.10.201.13: ICMP 10.10.201.12 udp port discard unreachable, length 556
        IP (tos 0x0, ttl 64, id 44971, offset 0, flags [none], proto UDP (17), length 1501)
    10.10.201.13.34237 > 10.10.201.12.discard: UDP, length 1473
19:39:43.074320 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.13 tell 10.10.201.12, length 28
19:39:43.074561 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.13 is-at b4:96:91:52:32:2e, length 46
19:39:43.554287 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.1 tell 10.10.201.12, length 28
19:39:43.554641 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.1 is-at 78:8a:20:ba:1a:de, length 46
19:40:08.466489 IP (tos 0x0, ttl 64, id 56471, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [.], cksum 0xa64a (incorrect -> 0x5445), ack 85, win 1424,
19:40:08.466637 IP (tos 0x0, ttl 64, id 56472, offset 0, flags [DF], proto TCP (6), length 172)
```

4)

Changing the value of num in the command and observing the tcp dump output

```

t3net03-55 ~ >: sock -v -u -i -n1 -w1484 10.10.201.13 discard
connected on 10.10.201.12.52965 to 10.10.201.13.9
wrote 1484 bytes
t3net03-56 ~ >: sock -v -u -i -n1 -w1485 10.10.201.13 discard
connected on 10.10.201.12.49859 to 10.10.201.13.9
wrote 1485 bytes
t3net03-57 ~ >: sock -v -u -i -n1 -w1486 10.10.201.13 discard
connected on 10.10.201.12.47122 to 10.10.201.13.9
wrote 1486 bytes
t3net03-58 ~ >: sock -v -u -i -n1 -w1487 10.10.201.13 discard
connected on 10.10.201.12.41091 to 10.10.201.13.9
wrote 1487 bytes
t3net03-59 ~ >: sock -v -u -i -n1 -w1488 10.10.201.13 discard
connected on 10.10.201.12.46091 to 10.10.201.13.9
wrote 1488 bytes
t3net03-60 ~ >: sock -v -u -i -n1 -w1489 10.10.201.13 discard
connected on 10.10.201.12.39204 to 10.10.201.13.9
wrote 1489 bytes
t3net03-61 ~ >: sock -v -u -i -n1 -w1490 10.10.201.13 discard
connected on 10.10.201.12.34270 to 10.10.201.13.9
wrote 1490 bytes
t3net03-62 ~ >: sock -v -u -i -n1 -w1491 10.10.201.13 discard
connected on 10.10.201.12.58511 to 10.10.201.13.9
wrote 1491 bytes
t3net03-63 ~ >: sock -v -u -i -n1 -w1492 10.10.201.13 discard
connected on 10.10.201.12.39545 to 10.10.201.13.9
wrote 1492 bytes
t3net03-64 ~ >: sock -v -u -i -n1 -w1493 10.10.201.13 discard
connected on 10.10.201.12.56299 to 10.10.201.13.9
wrote 1493 bytes
t3net03-65 ~ >: sock -v -u -i -n1 -w1494 10.10.201.13 discard
connected on 10.10.201.12.45703 to 10.10.201.13.9
wrote 1494 bytes
t3net03-66 ~ >: sock -v -u -i -n1 -w1495 10.10.201.13 discard
connected on 10.10.201.12.49562 to 10.10.201.13.9
wrote 1495 bytes
t3net03-67 ~ >: sock -v -u -i -n1 -w1470 10.10.201.13 discard
connected on 10.10.201.12.40472 to 10.10.201.13.9
wrote 1470 bytes
t3net03-68 ~ >: sock -v -u -i -n1 -w1471 10.10.201.13 discard
connected on 10.10.201.12.50264 to 10.10.201.13.9
wrote 1471 bytes
t3net03-69 ~ >: sock -v -u -i -n1 -w1472 10.10.201.13 discard
connected on 10.10.201.12.34598 to 10.10.201.13.9
wrote 1472 bytes
t3net03-70 ~ >: sock -v -u -i -n1 -w1473 10.10.201.13 discard
connected on 10.10.201.12.43334 to 10.10.201.13.9
wrote 1473 bytes
t3net03-71 ~ >: sock -v -u -i -n1 -w1474 10.10.201.13 discard
connected on 10.10.201.12.49785 to 10.10.201.13.9
wrote 1474 bytes
t3net03-72 ~ >: □

```

Tcpdump output observed when the sock -v -u -i -n1 -1 NUM <ip addr> discard command Was running

```

t3net03-46 ~ >: tcpdump host 10.10.201.12 and not broadcast and not host 128.235 -vn -i p1p1
tcpdump: listening on p1p1, link-type EN10MB (Ethernet), capture size 262144 bytes
20:13:50.466253 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.13 tell 10.10.201.12, length 28
20:13:50.466868 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.13 is-at b4:96:91:52:32:2e, length 46
20:13:52.790424 IP (tos 0x0, ttl 64, id 15559, offset 0, flags [+], proto UDP (17), length 740)
  10.10.201.12.47970 > 10.10.201.13.discard: UDP, bad length 713 > 712
20:13:52.790437 IP (tos 0x0, ttl 64, id 15559, offset 720, flags [none], proto UDP (17), length 21)
  10.10.201.12 > 10.10.201.13: ip-proto-17
20:13:52.790989 IP (tos 0xc0, ttl 64, id 45561, offset 0, flags [none], proto ICMP (1), length 576)
  10.10.201.13 > 10.10.201.12: ICMP host 10.10.201.13 unreachable - admin prohibited, length 556
    IP (tos 0x0, ttl 64, id 15559, offset 0, flags [none], proto UDP (17), length 741)
      10.10.201.12.47970 > 10.10.201.13.discard: UDP, length 713
20:13:57.795356 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.10.201.12 tell 10.10.201.13, length 46
20:13:57.795391 ARP, Ethernet (len 6), IPv4 (len 4), Reply 10.10.201.12 is-at b4:96:91:51:cf:14, length 28
^C
7 packets captured
7 packets received by filter

```

The output consists of discard UDP length messages of the specified values of NUM and different length depending on the offset value.

```
t3net03-45 ~ >: tcpdump host 10.10.201.12 and not broadcast and not host 128.235 -vn -i p1p1
tcpdump: listening on p1p1, link-type EN10MB (Ethernet), capture size 262144 bytes
20:10:03.794581 IP (tos 0x0, ttl 64, id 56562, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [.], cksum 0xa64a (incorrect -> 0x6ffa), ack 3361546282, win 1424, options [nop,nop,TS val 623641344 ecr 4113750534], length 0
20:10:03.794734 IP (tos 0x0, ttl 64, id 56563, offset 0, flags [DF], proto TCP (6), length 172)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [P.], cksum 0xa6c2 (incorrect -> 0x645b), seq 1:121, ack 1, win 1424, options [nop,nop,TS val 623641344 ecr 4113750534], length 120: NFS request xid 412960134
116 getattr fh 0,1/53
20:10:03.794994 IP (tos 0x0, ttl 64, id 56192, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.3.nfs > 10.10.201.12.vacdsm-app: Flags [.], cksum 0x6ff1 (correct), ack 1, win 1432, options [nop,nop,TS val 4113810694 ecr 623581184], length 0
20:10:03.795030 IP (tos 0x0, ttl 64, id 56193, offset 0, flags [DF], proto TCP (6), length 136)
    10.10.201.3.nfs > 10.10.201.12.vacdsm-app: Flags [P.], cksum 0x9744 (correct), seq 1:85, ack 121, win 1432, options [nop,nop,TS val 4113810694 ecr 623641344], length 84: NFS reply xid 412960134 reply ok 80 g
setattr NON 1 ids 0/815326306 sz 1448624223
20:10:03.795088 IP (tos 0x0, ttl 64, id 56564, offset 0, flags [DF], proto TCP (6), length 52)
    10.10.201.12.vacdsm-app > 10.10.201.3.nfs: Flags [.], cksum 0xa64a (incorrect -> 0x842c), ack 85, win 1424, options [nop,nop,TS val 623641344 ecr 4113810694], length 0
```

- 5) The maximum size of UDP datagram is found by using the command `sock -v -u -i -n1 -1 NUM` where NUM is a value between 65,535 and 65,500. At the value 65508 bytes according to the screen schort the write returned -1 and Message too long. The maximum size of UDP datagram will be 65507 bytes

```
File Edit View Search Terminal Help

To see your aliases, enter "alias"

t3net03-41 ~ >: sock -v -u -i -n1 -w65505 10.10.201.13 discard
connected on 10.10.201.12.45168 to 10.10.201.13.9
wrote 65505 bytes
t3net03-42 ~ >: sock -v -u -i -n1 -w65545 10.10.201.13 discard
connected on 10.10.201.12.34293 to 10.10.201.13.9
write returned -1, expected 65545: Message too long
t3net03-43 ~ >: sock -v -u -i -n1 -w655344 10.10.201.13 discard
connected on 10.10.201.12.45609 to 10.10.201.13.9
write returned -1, expected 655344: Message too long
t3net03-44 ~ >: sock -v -u -i -n1 -w65535 10.10.201.13 discard
connected on 10.10.201.12.50317 to 10.10.201.13.9
write returned -1, expected 65535: Message too long
t3net03-45 ~ >: sock -v -u -i -n1 -w65506 10.10.201.13 discard
connected on 10.10.201.12.40255 to 10.10.201.13.9
wrote 65506 bytes
t3net03-46 ~ >: sock -v -u -i -n1 -w65507 10.10.201.13 discard
connected on 10.10.201.12.46701 to 10.10.201.13.9
wrote 65507 bytes
t3net03-47 ~ >: sock -v -u -i -n1 -w65508 10.10.201.13 discard
connected on 10.10.201.12.47936 to 10.10.201.13.9
write returned -1, expected 65508: Message too long
t3net03-48 ~ >: 
```

- 6) The command to write 6000 bytes and the output is “wrote 6000 bytes”

```
t3net03-44 ~ >: sock -v -u -i -n1 -w6000 10.10.201.13 discard  
connected on 10.10.201.12.50203 to 10.10.201.13.9  
wrote 6000 bytes
```

The generated data packets on the tcpdump window is the hex file which is then saved as a .pcap file and decided in wireshark.

```
t3net03-49 ~ >: tcpdump -x udp and host 10.10.201.12 and not broadcast and not host 128.235 -n -i p1p1  
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode  
listening on p1p1, link-type EN10MB (Ethernet), capture size 262144 bytes  
20:26:44.705450 IP 10.10.201.12.50203 > 10.10.201.13.discard: UDP, bad length 6000 > 1472  
0x0000: 4500 05dc cae6 2000 4011 e3fc 0a0a c90c  
0x0010: 0a0a c90d c41b 0009 1778 1683 2021 2223  
0x0020: 2425 2627 2829 2a2b 2c2d 2e2f 3031 3233  
0x0030: 3435 3637 3839 3a3b 3c3d 3e3f 4041 4243  
0x0040: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253  
0x0050: 5455 5657 5859 5a5b 5c5d 5e5f 6061 6263  
0x0060: 6465 6667 6869 6a6b 6c6d 6e6f 7071 7273  
0x0070: 7475 7677 7879 7a7b 7c7d 7e20 2122 2324  
0x0080: 2526 2728 292a 2b2c 2d2e 2f30 3132 3334  
0x0090: 3536 3738 393a 3b3c 3d3e 3f40 4142 4344  
0x00a0: 4546 4748 494a 4b4c 4d4e 4f50 5152 5354  
0x00b0: 5556 5758 595a 5b5c 5d5e 5f60 6162 6364  
0x00c0: 6566 6768 696a 6b6c 6d6e 6f70 7172 7374  
0x00d0: 7576 7778 797a 7b7c 7d7e 2021 2223 2425  
0x00e0: 2627 2829 2a2b 2c2d 2e2f 3031 3233 3435  
0x00f0: 3637 3839 3a3b 3c3d 3e3f 4041 4243 4445  
0x0100: 4647 4849 4a4b 4c4d 4e4f 5051 5253 5455  
0x0110: 5657 5859 5a5b 5c5d 5e5f 6061 6263 6465  
0x0120: 6667 6869 6a6b 6c6d 6e6f 7071 7273 7475  
0x0130: 7677 7879 7a7b 7c7d 7e20 2122 2324 2526  
0x0140: 2728 292a 2b2c 2d2e 2f30 3132 3334 3536  
0x0150: 3738 393a 3b3c 3d3e 3f40 4142 4344 4546
```

0x03c0:	5455	5657	5859	5a5b	5c5d	5e5f	6061	6263
0x03d0:	6465	6667	6869	6a6b	6c6d	6e6f	7071	7273
0x03e0:	7475	7677	7879	7a7b	7c7d	7e20	2122	2324
0x03f0:	2526	2728	292a	2b2c	2d2e	2f30	3132	3334
0x0400:	3536	3738	393a	3b3c	3d3e	3f40	4142	4344
0x0410:	4546	4748	494a	4b4c	4d4e	4f50	5152	5354
0x0420:	5556	5758	595a	5b5c	5d5e	5f60	6162	6364
0x0430:	6566	6768	696a	6b6c	6d6e	6f70	7172	7374
0x0440:	7576	7778	797a	7b7c	7d7e	2021	2223	2425
0x0450:	2627	2829	2a2b	2c2d	2e2f	3031	3233	3435
0x0460:	3637	3839	3a3b	3c3d	3e3f	4041	4243	4445
0x0470:	4647	4849	4a4b	4c4d	4e4f	5051	5253	5455
0x0480:	5657	5859	5a5b	5c5d	5e5f	6061	6263	6465
0x0490:	6667	6869	6a6b	6c6d	6e6f	7071	7273	7475
0x04a0:	7677	7879	7a7b	7c7d	7e20	2122	2324	2526
0x04b0:	2728	292a	2b2c	2d2e	2f30	3132	3334	3536
0x04c0:	3738	393a	3b3c	3d3e	3f40	4142	4344	4546
0x04d0:	4748	494a	4b4c	4d4e	4f50	5152	5354	5556
0x04e0:	5758	595a	5b5c	5d5e	5f60	6162	6364	6566
0x04f0:	6768	696a	6b6c	6d6e	6f70	7172	7374	7576
0x0500:	7778	797a	7b7c	7d7e	2021	2223	2425	2627
0x0510:	2829	2a2b	2c2d	2e2f	3031	3233	3435	3637
0x0520:	3839	3a3b	3c3d	3e3f	4041	4243	4445	4647
0x0530:	4849	4a4b	4c4d	4e4f	5051	5253	5455	5657
0x0540:	5859	5a5b	5c5d	5e5f	6061	6263	6465	6667
0x0550:	6869	6a6b	6c6d	6e6f	7071	7273	7475	7677
0x0560:	7879	7a7b	7c7d	7e20	2122	2324	2526	2728
0x0570:	292a	2b2c	2d2e	2f30	3132	3334	3536	3738
0x0580:	393a	3b3c	3d3e	3f40	4142	4344	4546	4748
0x0590:	494a	4b4c	4d4e	4f50	5152	5354	5556	5758
0x05a0:	595a	5b5c	5d5e	5f60	6162	6364	6566	6768
0x05b0:	696a	6b6c	6d6e	6f70	7172	7374	7576	7778
0x05c0:	797a	7b7c	7d7e	2021	2223	2425	2627	2829
0x05d0:	2a2b	2c2d	2e2f	3031	3233	3435		

```
20:26:44.705606 IP 10.10.201.12 > 10.10.201.13: ip-proto-17
0x0000: 4500 006c cae6 02e4 4011 0689 0a0a c90c
0x0010: 0a0a c90d 3637 3839 3a3b 3c3d 3e3f 4041
0x0020: 4243 4445 4647 4849 4a4b 4c4d 4e4f 5051
0x0030: 5253 5455 5657 5859 5a5b 5c5d 5e5f 6061
0x0040: 6263 6465 6667 6869 6a6b 6c6d 6e6f 7071
0x0050: 7273 7475 7677 7879 7a7b 7c7d 7e20 2122
0x0060: 2324 2526 2728 292a 2b2c 2d2e

^C
5 packets captured
5 packets received by filter
0 packets dropped by kernel
```

Command to capture the tcpdump output in .pcap file

```
t3net03-50 ~ >: tcpdump -x udp and host 10.10.201.12 and not broadcast and not host 128.235 -n -i p1p1 -w tcpdump5551.pcap
tcpdump: listening on p1p1, link-type EN10MB (Ethernet), capture size 262144 bytes
^C15 packets captured
15 packets received by filter
0 packets dropped by kernel
```

The tcpdump output when observed in the wireshark has 3 UDP packets

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	10.10.201.12	10.10.201.13	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=0, ID=ea2f) [Reassembled in #5]
2	0.000023	10.10.201.12	10.10.201.13	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=1480, ID=ea2f) [Reassembled in #5]
3	0.000029	10.10.201.12	10.10.201.13	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=2960, ID=ea2f) [Reassembled in #5]
4	0.000034	10.10.201.12	10.10.201.13	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=4440, ID=ea2f) [Reassembled in #5]
5	0.000108	10.10.201.12	10.10.201.13	UDP	122	48873 → 9 Len=6000
6	21.783924	10.10.201.13	10.10.201.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=0, ID=fef6) [Reassembled in #10]
7	21.783947	10.10.201.13	10.10.201.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=1480, ID=fef6) [Reassembled in #10]
8	21.783951	10.10.201.13	10.10.201.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=2960, ID=fef6) [Reassembled in #10]
9	21.783954	10.10.201.13	10.10.201.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=4440, ID=fef6) [Reassembled in #10]
10	21.783957	10.10.201.13	10.10.201.12	UDP	122	47908 → 9 Len=6000
11	86.342433	10.10.201.13	10.10.201.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=0, ID=9284) [Reassembled in #15]
12	86.342452	10.10.201.13	10.10.201.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=1480, ID=9284) [Reassembled in #15]
13	86.342456	10.10.201.13	10.10.201.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=2960, ID=9284) [Reassembled in #15]
14	86.342459	10.10.201.13	10.10.201.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=4440, ID=9284) [Reassembled in #15]
15	86.342462	10.10.201.13	10.10.201.12	UDP	122	37245 → 9 Len=6000

1st Packet of UDP with UDP header information and the UDP payload of 6000 bytes.

Wireshark - Packet 5 · tcpdump5551.pcap

```
> Frame 5: 122 bytes on wire (976 bits), 122 bytes captured (976 bits)
> Ethernet II, Src: IntelCor_51:cf:14 (b4:96:91:51:cf:14), Dst: IntelCor_52:32:2e (b4:96:91:52:32:2e)
> Internet Protocol Version 4, Src: 10.10.201.12, Dst: 10.10.201.13
`- User Datagram Protocol, Src Port: 48873, Dst Port: 9
    Source Port: 48873
    Destination Port: 9
    Length: 6008
    Checksum: 0x1bb5 [unverified]
    [Checksum Status: Unverified]
    [Stream index: 0]
`- [Timestamps]
    UDP payload (6000 bytes)

0000 b4 96 91 52 32 2e b4 96 91 51 cf 14 08 00 45 00 ...R2... .Q....E.
0010 00 6c ea 2f 02 e4 40 11 e7 3f 0a 0a c9 0c 0a 0a .1./..@. .?.....
0020 c9 0d 36 37 38 39 3a 3b 3c 3d 3e 3f 40 41 42 43 ..6789:; <=>?@ABC
0030 44 45 46 47 48 49 4a 4b 4c 4d 4e 4f 50 51 52 53 DEFGHIJK LMNOPQRS
0040 54 55 56 57 58 59 5a 5b 5c 5d 5e 5f 60 61 62 63 TUVWXYZ[ \]^_`abc
0050 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f 70 71 72 73 defghijk lmnopqrs
0060 74 75 76 77 78 79 7a 7b 7c 7d 7e 20 21 22 23 24 tuvwxyz{ |}~ !"#$%
0070 25 26 27 28 29 2a 2b 2c 2d 2e %%'()*+, -.
```

2nd Packet of UDP with UDP header information and the UDP payload of 6000 bytes.

```
Wireshark - Packet 10 · tcpdump5551.pcap

> Frame 10: 122 bytes on wire (976 bits), 122 bytes captured (976 bits)
> Ethernet II, Src: IntelCor_52:32:2e (b4:96:91:52:32:2e), Dst: IntelCor_51:cf:14 (b4:96:91:51:cf:14)
> Internet Protocol Version 4, Src: 10.10.201.13, Dst: 10.10.201.12
└ User Datagram Protocol, Src Port: 47908, Dst Port: 9
    Source Port: 47908
    Destination Port: 9
    Length: 6008
    Checksum: 0x1f7a [unverified]
        [Checksum Status: Unverified]
        [Stream index: 1]
    > [Timestamps]
    UDP payload (6000 bytes)

0000 b4 96 91 51 cf 14 b4 96 91 52 32 2e 08 00 45 00  ···Q··· ·R2..·E·
0010 00 6c fe f6 02 e4 40 11 d2 78 0a 0a c9 0d 0a 0a ·1···@· ·x·····
0020 c9 0c 36 37 38 39 3a 3b 3c 3d 3e 3f 40 41 42 43 ··6789:; <=>?@ABC
0030 44 45 46 47 48 49 4a 4b 4c 4d 4e 4f 50 51 52 53 DEFGHIJK LMNOPQRS
0040 54 55 56 57 58 59 5a 5b 5c 5d 5e 5f 60 61 62 63 TUVWXYZ[ \]^_`abc
0050 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f 70 71 72 73 defghijk lmnopqrs
0060 74 75 76 77 78 79 7a 7b 7c 7d 7e 20 21 22 23 24 tuvwxyz{ |}~ !"#$
0070 25 26 27 28 29 2a 2b 2c 2d 2e %&'()*+, -.
```

3rd Packet of UDP with UDP header information and the UDP payload of 6000 bytes.

```
Wireshark - Packet 15 · tcpdump5551.pcap

> Frame 15: 122 bytes on wire (976 bits), 122 bytes captured (976 bits)
> Ethernet II, Src: IntelCor_52:32:2e (b4:96:91:52:32:2e), Dst: IntelCor_51:cf:14 (b4:96:91:51:cf:14)
> Internet Protocol Version 4, Src: 10.10.201.13, Dst: 10.10.201.12
└ User Datagram Protocol, Src Port: 37245, Dst Port: 9
    Source Port: 37245
    Destination Port: 9
    Length: 6008
    Checksum: 0x4921 [unverified]
        [Checksum Status: Unverified]
        [Stream index: 2]
        [Timestamps]
    UDP payload (6000 bytes)

0000 b4 96 91 51 cf 14 b4 96 91 52 32 2e 08 00 45 00 ...Q..... R2...E...
0010 00 6c 92 84 02 e4 40 11 3e eb 0a 0a c9 0d 0a 0a .1.....@. >.....
0020 c9 0c 36 37 38 39 3a 3b 3c 3d 3e 3f 40 41 42 43 ..6789:; <=>?@ABC
0030 44 45 46 47 48 49 4a 4b 4c 4d 4e 4f 50 51 52 53 DEFGHIJK LMNOPQRS
0040 54 55 56 57 58 59 5a 5b 5c 5d 5e 5f 60 61 62 63 TUVWXYZ[ \]^_`abc
0050 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f 70 71 72 73 defghijk lmnopqrs
0060 74 75 76 77 78 79 7a 7b 7c 7d 7e 20 21 22 23 24 tuvwxyz{ |}~ !"#$%
0070 25 26 27 28 29 2a 2b 2c 2d 2e %&'()*+, -. 
```