

Final Project

Computer Networking Course

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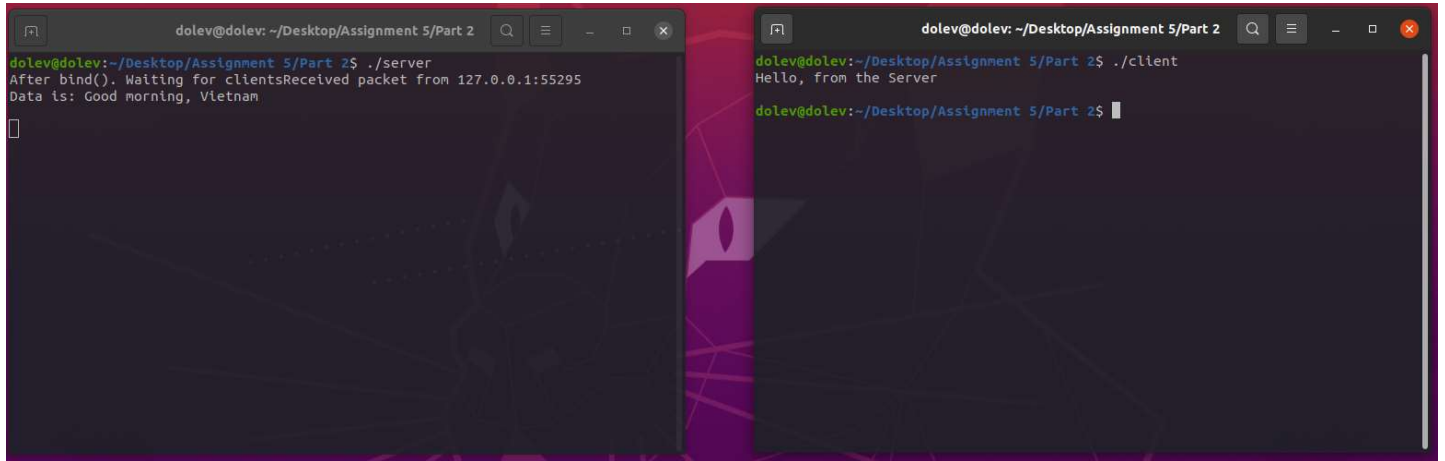
Part 1:

```
dolev@dolev: ~/Desktop/Assignment 5/Part 1
dolev@dolev:~/Desktop/Assignment 5/Part 1$ python3 UDPPingerClient.py
Request timed out
2 PING 0.00010323524475097656
3 PING 3.981590270996094e-05
4 PING 3.647804260253906e-05
5 PING 3.4332275390625e-05
Request timed out
Request timed out
8 PING 0.00018072128295898438
9 PING 8.296966552734375e-05
10 PING 7.867813110351562e-05
min: 3.4332275390625e-05 max: 0.00018072128295898438 average: 7.946150643484933e-05 loss:30%
dolev@dolev:~/Desktop/Assignment 5/Part 1$
```

```
dolev@dolev: ~/Desktop/Assignment 5/Part 1
dolev@dolev:~/Desktop/Assignment 5/Part 1$ python3 HeartbeatClient.py
PING loss: 0 time difference: 0.0001418590545654297
PING loss: 0 time difference: 4.506111145019531e-05
PING loss: 0 time difference: 3.62396240234375e-05
PING loss: 0 time difference: 3.719329833984375e-05
PING loss: 0 time difference: 3.743171691894531e-05
Request timed out
PING loss: 0 time difference: 0.00016236305236816406
PING loss: 0 time difference: 0.0001285076141357422
PING loss: 0 time difference: 0.00012493133544921875
PING loss: 0 time difference: 0.0001087188720703125
min: 9.775161743164062e-05 max: 0.0003466606140136719 average: 0.00021179517110188803 loss:10%
dolev@dolev:~/Desktop/Assignment 5/Part 1$
```

Part 2:

Screen shot of two programs, client and server that used IPv4 :

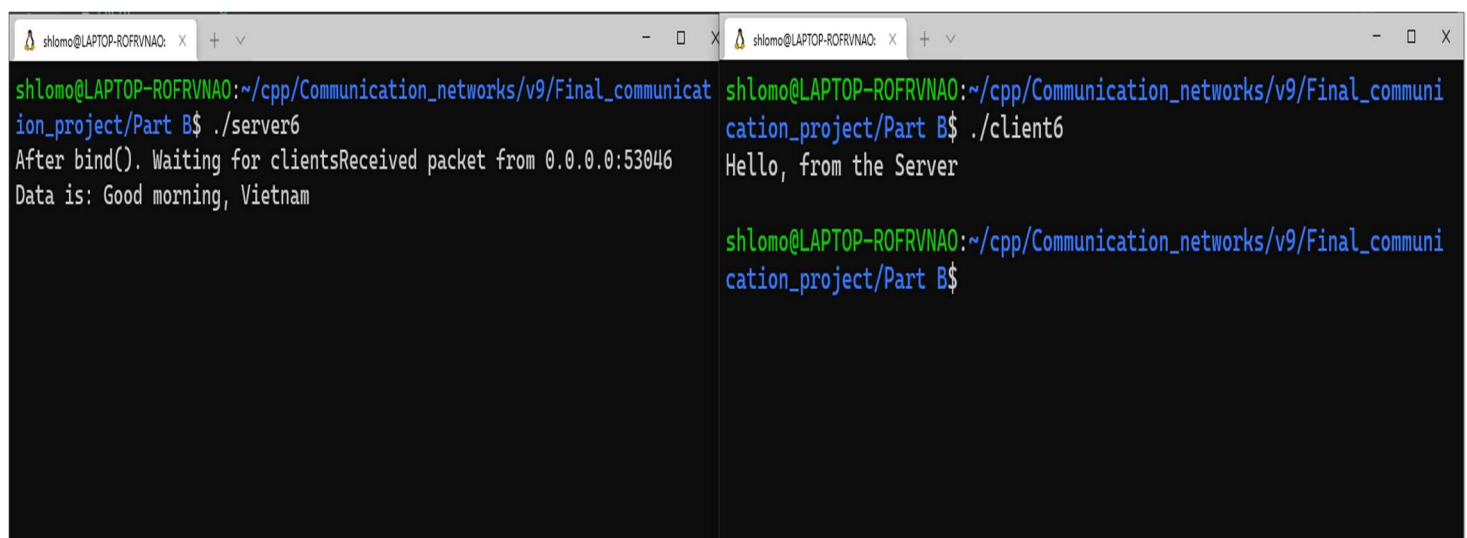


The image shows two terminal windows side-by-side. The left window is titled 'dolev@dolev: ~/Desktop/Assignment 5/Part 2' and shows the execution of a server program. The right window is also titled 'dolev@dolev: ~/Desktop/Assignment 5/Part 2' and shows the execution of a client program.

```
dolev@dolev:~/Desktop/Assignment 5/Part 2$ ./server
After bind(). Waiting for clientsReceived packet from 127.0.0.1:55295
Data ts: Good morning, Vietnam
[]

dolev@dolev:~/Desktop/Assignment 5/Part 2$ ./client
Hello, from the Server
dolev@dolev:~/Desktop/Assignment 5/Part 2$
```

Screen shot of two programs, client and server that used IPv6 :



The image shows two terminal windows side-by-side. The left window is titled 'shlomo@LAPTOP-ROFRVNAO: ~' and shows the execution of a server program. The right window is also titled 'shlomo@LAPTOP-ROFRVNAO: ~' and shows the execution of a client program.

```
shlomo@LAPTOP-ROFRVNAO:~/cpp/Communication_networks/v9/Final_communication_project/Part B$ ./server6
After bind(). Waiting for clientsReceived packet from 0.0.0.0:53046
Data is: Good morning, Vietnam

shlomo@LAPTOP-ROFRVNAO:~/cpp/Communication_networks/v9/Final_communication_project/Part B$ ./client6
Hello, from the Server

shlomo@LAPTOP-ROFRVNAO:~/cpp/Communication_networks/v9/Final_communication_project/Part B$
```

Screen shot of using the netstat -na command before running the programs :

```
dolev@dolev: ~/Desktop/Assignment 5/Part 2
dolev@dolev:~/Desktop/Assignment 5/Part 2$ netstat -a
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 localhost:domain        0.0.0.0:*               LISTEN
tcp        0      0 localhost:ipp           0.0.0.0:*               LISTEN
tcp        0      0 dolev:39604             ssl.gstatic.com:https   TIME_WAIT
tcp        0      0 dolev:48594             fra16s48-in-f14.1:https ESTABLISHED
tcp        0      0 dolev:60402             ec2-52-35-141-160:https ESTABLISHED
tcp        0      0 dolev:48596             fra16s48-in-f14.1:https ESTABLISHED
tcp6       0      0 ip6-localhost:ipp      [::]:*                  LISTEN
udp        0      0 0.0.0.0:45382          0.0.0.0:*               LISTEN
udp        0      0 0.0.0.0:631            0.0.0.0:*               LISTEN
udp        0      0 0.0.0.0:mdns           0.0.0.0:*               LISTEN
udp        0      0 localhost:domain       0.0.0.0:*               LISTEN
udp        0      0 0.0.0.0:45113          0.0.0.0:*               LISTEN
udp        0      0 dolev:bootpc           _gateway:bootps        ESTABLISHED
udp6       0      0 [::]:mdns              [::]:*                  LISTEN
udp6       0      0 [::]:43105             [::]:*                  LISTEN
raw6       0      0 [::]:ipv6-icmp         [::]:*                  LISTEN
7

Active UNIX domain sockets (servers and established)
Proto RefCnt Flags       Type       State      I-Node  Path
unix   2      [ ACC ] STREAM    LISTENING   25869   @/tmp/dbus-wLxSC2Qh
unix   2      [ ACC ] SEQPACKET LISTENING   15199   /run/udev/control
unix   2      [ ACC ] STREAM    LISTENING   15172   /run/systemd/private
unix   2      [ ]       DGRAM      LISTENING   30772   /run/user/1000/systemd/notify
unix   2      [ ACC ] STREAM    LISTENING   15174   /run/systemd/userdb/io.systemd.DynamicUser
unix   2      [ ACC ] STREAM    LISTENING   30775   /run/user/1000/systemd/private
unix   2      [ ACC ] STREAM    LISTENING   30828   /run/user/1000/bus
unix   2      [ ]       DGRAM      LISTENING   15183   /run/systemd/journal/syslog
unix   2      [ ACC ] STREAM    LISTENING   15185   /run/systemd/fsck.progress
unix   2      [ ACC ] STREAM    LISTENING   30829   /run/user/1000/gnupg/S.dirmngr
unix   2      [ ACC ] STREAM    LISTENING   30830   /run/user/1000/gnupg/S.gpg-agent.browser
```

Screen shot of using the netstat -na command after running the programs :

```
dolev@dolev: ~/Desktop/Assignment 5/Part 2
dolev@dolev:~/Desktop/Assignment 5/Part 2$ netstat -na
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 127.0.0.53:53          0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:631          0.0.0.0:*               LISTEN
tcp        0      0 10.0.2.15:46588        142.250.185.163:443     TIME_WAIT
tcp        0      0 10.0.2.15:56736        142.250.186.78:443     ESTABLISHED
tcp        0      0 10.0.2.15:56936        142.250.185.238:443     ESTABLISHED
tcp        0      0 10.0.2.15:60402        52.35.141.160:443     ESTABLISHED
tcp        0      0 10.0.2.15:45598        142.250.181.238:443     ESTABLISHED
tcp        0      0 10.0.2.15:52350        142.250.184.193:443     ESTABLISHED
tcp6       0      0 :::631                 :::*                     LISTEN
udp        0      0 0.0.0.0:45382          0.0.0.0:*               LISTEN
udp        0      0 0.0.0.0:631            0.0.0.0:*               LISTEN
udp        0      0 127.0.0.1:5060         0.0.0.0:*               LISTEN
udp        0      0 0.0.0.0:5353           0.0.0.0:*               LISTEN
udp        0      0 127.0.0.53:53          0.0.0.0:*               LISTEN
udp        0      0 0.0.0.0:45113          0.0.0.0:*               LISTEN
udp        0      0 10.0.2.15:68           10.0.2.2:67             ESTABLISHED
udp6       0      0 :::5353                :::*                     LISTEN
udp6       0      0 :::43105               :::*                     LISTEN
raw6       0      0 :::58                  :::*                     LISTEN
7

Active UNIX domain sockets (servers and established)
Proto RefCnt Flags       Type       State      I-Node  Path
unix   2      [ ACC ] STREAM    LISTENING   25869   @/tmp/dbus-wLxSC2Qh
unix   2      [ ACC ] SEQPACKET LISTENING   15199   /run/udev/control
unix   2      [ ACC ] STREAM    LISTENING   15172   /run/systemd/private
unix   2      [ ]       DGRAM      LISTENING   30772   /run/user/1000/systemd/notify
unix   2      [ ACC ] STREAM    LISTENING   15174   /run/systemd/userdb/io.systemd.DynamicUser
unix   2      [ ACC ] STREAM    LISTENING   30775   /run/user/1000/systemd/private
unix   2      [ ACC ] STREAM    LISTENING   30828   /run/user/1000/bus
unix   2      [ ]       DGRAM      LISTENING   15183   /run/systemd/journal/syslog
unix   2      [ ACC ] STREAM    LISTENING   15185   /run/systemd/fsck.progress
unix   2      [ ACC ] STREAM    LISTENING   30829   /run/user/1000/gnupg/S.dirmngr
unix   2      [ ACC ] STREAM    LISTENING   30830   /run/user/1000/gnupg/S.gpg-agent.browser
unix   15     [ ]       DGRAM      LISTENING   15193   /run/systemd/journal/dev-log
```

Comparison between IPV4 and IPV6 headers :

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	127.0.0.1	127.0.0.1	UDP	67	38786 → 5060 Len=23
2	0.000037	127.0.0.1	127.0.0.1	UDP	68	5060 → 38786 Len=24

```

> Frame 1: 67 bytes on wire (536 bits), 67 bytes captured (536 bits)
> Linux cooked capture v1
▼ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
    > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 51
    Identification: 0xae03 (44547)
    > Flags: 0x40, Don't fragment
    Fragment Offset: 0
    Time to Live: 64
    Protocol: UDP (17)
    Header Checksum: 0x8eb4 [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 127.0.0.1
    Destination Address: 127.0.0.1

```

```

▼ User Datagram Protocol, Src Port: 38786, Dst Port: 5060
    Source Port: 38786
    Destination Port: 5060
    Length: 31
    Checksum: 0xfe32 [unverified]
    [Checksum Status: Unverified]
    [Stream index: 0]

```

No.	Time	Source	Destination	Protocol	Length	Info
4	11.591838	:::1	:::1	UDP	87	41901 → 5060 Len=23
5	11.591899	:::1	:::1	UDP	88	5060 → 41901 Len=24

```

> Frame 4: 87 bytes on wire (696 bits), 87 bytes captured (696 bits)
> Linux cooked capture v1
▼ Internet Protocol Version 6, Src: ::1, Dst: ::1
    0110 .... = Version: 6
    > .... 0000 0000 .... = Traffic Class: 0x00 (DSCP: CS0, ECN: Not-ECT)
    .... 1010 1001 0011 1011 0110 = Flow Label: 0xa93b6
    Payload Length: 31
    Next Header: UDP (17)
    Hop Limit: 64
    Source Address: ::1
    Destination Address: ::1

```

```

▼ User Datagram Protocol, Src Port: 41901, Dst Port: 5060
    Source Port: 41901
    Destination Port: 5060
    Length: 31
    Checksum: 0x0032 [unverified]
    [Checksum Status: Unverified]
    [Stream index: 0]

```

The IPv4 has 32 - bit address length and the IPv6 has 128 - bit address length.

The IPv4 uses a numeric (decimal) addressing method , and The IPv6 using hexadecimal representation.

The header length of 20 bytes in IPv4 whereas the header length is 40 bytes in IPv6. IPv4 uses the checksum field in the header format for handling errors whereas the IPv6 doesn't have this field.

IPv6 has no fragmentation, the Sender must send packages of the appropriate size and not packages that are too large.

