

## Lab 2: UDP Pinger Lab

In this lab, you will learn the basics of socket programming for UDP in Python. You will learn how to send and receive datagram packets using UDP sockets and also, how to set a proper socket timeout. Throughout the lab, you will gain familiarity with a Ping application and its usefulness in computing statistics such as packet loss rate.

You will first study a simple Internet ping server written in the Python, and implement a corresponding client. The functionality provided by these programs is similar to the functionality provided by standard ping programs available in modern operating systems. However, these programs use a simpler protocol, UDP, rather than the standard Internet Control Message Protocol (ICMP) to communicate with each other. The ping protocol allows a client machine to send a packet of data to a remote machine, and have the remote machine return the data back to the client unchanged (an action referred to as echoing). Among other uses, the ping protocol allows hosts to determine round-trip times to other machines.

You are given the complete code for the Ping server below. Your task is to write the Ping client.

### Server Code

The following code fully implements a ping server. You need to compile and run this code before running your client program. *You do not need to modify this code.*

In this server code, 30% of the client's packets are simulated to be lost. You should study this code carefully, as it will help you write your ping client.

```
# UDPPingerServer.py
# We will need the following module to generate randomized lost packets
import random
from socket import *

# Create a UDP socket
# Notice the use of SOCK_DGRAM for UDP packets
serverSocket = socket(AF_INET, SOCK_DGRAM)
# Assign IP address and port number to socket
serverSocket.bind(('', 12000))

while True:
    # Generate random number in the range of 0 to 10
    rand = random.randint(0, 10)
    # Receive the client packet along with the address it is coming from
    message, address = serverSocket.recvfrom(1024)
    # Capitalize the message from the client
    message = message.upper()
```

```
# If rand is less is than 4, we consider the packet lost and do not respond
if rand < 4:
    continue
# Otherwise, the server responds
serverSocket.sendto(message, address)
```

The server sits in an infinite loop listening for incoming UDP packets. When a packet comes in and if a randomized integer is greater than or equal to 4, the server simply capitalizes the encapsulated data and sends it back to the client.

## Packet Loss

UDP provides applications with an unreliable transport service. Messages may get lost in the network due to router queue overflows, faulty hardware or some other reasons. Because packet loss is rare or even non-existent in typical campus networks, the server in this lab injects artificial loss to simulate the effects of network packet loss. The server creates a variable randomized integer which determines whether a particular incoming packet is lost or not.

## Client Code

You need to implement the following client program.

The client should send 10 pings to the server. Because UDP is an unreliable protocol, a packet sent from the client to the server may be lost in the network, or vice versa. For this reason, the client cannot wait indefinitely for a reply to a ping message. You should get the client wait up to one second for a reply; if no reply is received within one second, your client program should assume that the packet was lost during transmission across the network. You will need to look up the Python documentation to find out how to set the timeout value on a datagram socket.

Specifically, your client program should

- (1) send the ping message using UDP (Note: Unlike TCP, you do not need to establish a connection first, since UDP is a connectionless protocol.)
- (2) print the response message from server, if any
- (3) calculate and print the round trip time (RTT), in seconds, of each packet, if server responses
- (4) otherwise, print "Request timed out"

During development, you should run the `UDPPingerServer.py` on your machine, and test your client by sending packets to *localhost* (or, 127.0.0.1). After you have fully debugged your code, you should see how your application communicates across the network with the ping server and ping client running on different machines.

## Message Format

The ping messages in this lab are formatted in a simple way. The client message is one line, consisting of ASCII characters in the following format:

*Ping sequence\_number time*

where *sequence\_number* starts at 1 and progresses to 10 for each successive ping message sent by the client, and *time* is the time when the client sends the message.

## What to Hand in

You will hand in the complete client code and screenshots at the client verifying that your ping program works as required.

```
# UDPPingerClient.py
import sys, time

from socket import *

# Get the server hostname and port as command line
arguments
argv = #Fill in

host = #Fill in
port = #Fill in
timeout = #Fill in

# Create UDP client socket

# Note the use of SOCK_DGRAM for UDP datagram
packet

#Fill in

# Set socket timeout as 1 second

#Fill in

# Command line argument is a string, change the
port into integer

#Fill in

# Sequence number of the ping message
ptime = 0

# Ping for 10 times
while ptime < 10:
    ptime += 1

    # Format the message to be sent
    data = "Ping " + str(ptime) + " " +
time.asctime()

    try:

        # Sent time

        #Fill in

        # Send the UDP packet with the ping message
        clientsocket.sendto(data.encode(), (host,
```

```
port))

    # Receive the server response

    message, address =
clientsocket.recvfrom(1024)

    # Received time

    #Fill in

    # Display the server response as an output

    print("Reply from " + address[0] + ": "
+ message.decode())

    # Round trip time is the difference between
sent and received time

    #Fill in

except:

    # Server does not respond

    # Assume the packet is lost

    print ("Request timed out.")

    continue

# Close the client socket

#Fill in
```