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Section: Gx

Subject : Computer Network Lab (CS 3272)

Assignment 4 extension: UDP Socket Application

Code:

server.cpp

```
// 2020CSB010 GOURAV KUMAR SHAW

#include <iostream>
#include <cstring>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>
#include <unistd.h>

#define BUFFER_SIZE 1024

const int MAX_PAYLOAD_SIZE = 1000;

int main(int argc, char * argv[]) {

    if (argc < 2) {
        std::cerr << "Usage: " << argv[0] << " <port>\n";
        return 1;
    }

    int port = atoi(argv[1]);

    int sockfd = socket(AF_INET, SOCK_DGRAM, 0);
    if (sockfd < 0) {
        std::cerr << "Error creating socket.\n";
        return 1;
    }

    struct sockaddr_in servaddr, cliaddr;
    memset(&servaddr, 0, sizeof(servaddr));
```

```
    memset(&cliaddr, 0, sizeof(cliaddr));

    servaddr.sin_family = AF_INET;
    servaddr.sin_addr.s_addr = INADDR_ANY;
    servaddr.sin_port = htons(port);

    if (bind(sockfd, (const struct sockaddr *) &servaddr, sizeof(servaddr)) <
0) {
        std::cerr << "Error binding socket.\n";
        close(sockfd);
        return 1;
    }

    char buffer[BUFFER_SIZE];
    socklen_t len;

    len = sizeof(cliaddr);

    while (true) {
        struct Packet {
            uint16_t sequence_number;
            uint32_t timestamp;
            uint8_t ttl;
            uint8_t payload[MAX_PAYLOAD_SIZE];
        } recv_packet;

        int n = recvfrom(sockfd, &recv_packet, BUFFER_SIZE, MSG_WAITALL,
(struct sockaddr *) &cliaddr, &len);
        if (n < 0) {
            std::cerr << "Error receiving packet.\n";
            continue;
        }

        // Decrement TTL value by one
        recv_packet.ttl--;

        // Send the same packet back to the client
        if (sendto(sockfd, &recv_packet, sizeof(buffer), MSG_CONFIRM, (const
struct sockaddr *) &cliaddr, len) < 0) {
            perror("sendto");
            continue;
        }
    }

    close(sockfd);
    return 0;
}
```

client.cpp

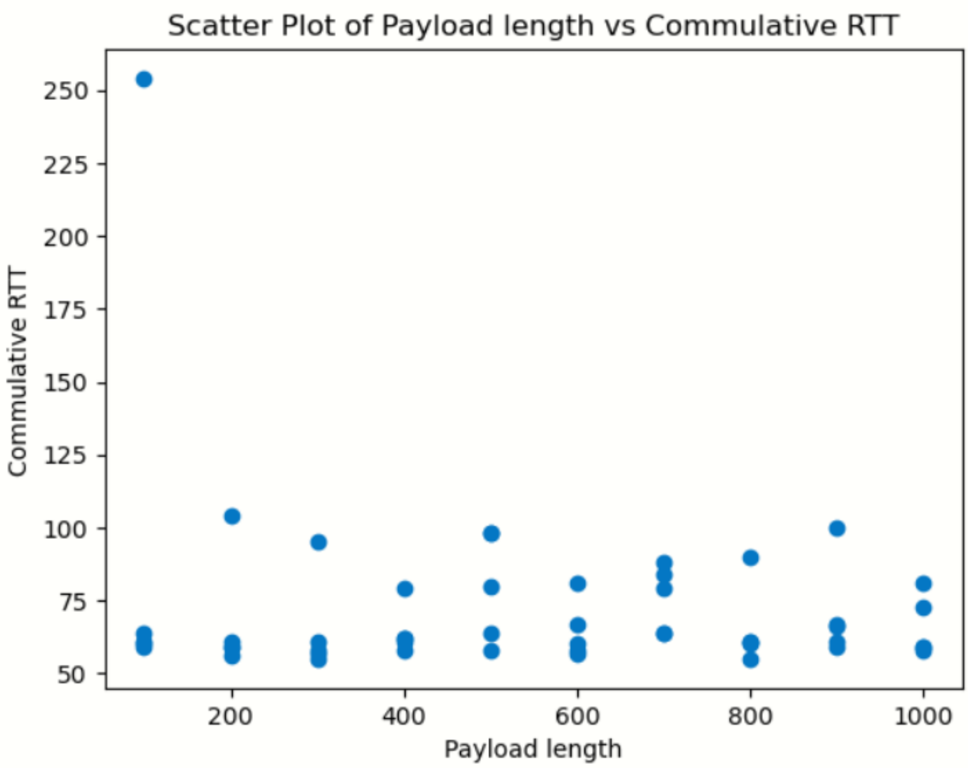
```
// 2020CSB010 GOURAV KUMAR SHAW

#include <bits/stdc++.h>
#include <string.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <arpa/inet.h>
#include <netinet/in.h>
#include <sys/time.h>
#include <stdlib.h>
#include <fcntl.h>
#include <unistd.h>

#define MAXSIZE 1600
using namespace std;
// Driver code
int main(int argc, char *argv[])
{
    // defining the payload

    unordered_map<int, int> m;
    FILE *fp1;
    int k = 100;

    vector<int> vec1;
    vector<int> vec2;
    for (int i = 0; i < 10; i++)
    {
        m[i] = k;
        k += 100;
    }
    if (argc != 6)
    {
        std::cerr << "Use the following arguments: " << argv[0] << "
[ip_address] [port_number] [TTL] [NumPackets] [Filename.csv]\n";
        return 1;
    }
    srand(time(NULL));
    const int PORT = atoi(argv[2]);
    int sockfd;
    char filename[10];
    memcpy(filename, argv[5], sizeof(argv[5]));
    printf("Filename is %s\n", filename);

    struct sockaddr_in servaddr;
    if ((sockfd = socket(AF_INET, SOCK_DGRAM, 0)) < 0)
```

```
    {
        perror("socket creation failed");
        exit(EXIT_FAILURE);
    }

    memset(&servaddr, 0, sizeof(servaddr));

    // Filling server information
    servaddr.sin_family = AF_INET;
    servaddr.sin_port = htons(PORT);
    servaddr.sin_addr.s_addr = inet_addr(argv[1]);


    socklen_t len;
    struct timeval timestamp;
    struct timeval timestamp1;

    int numPacket = atoi(argv[4]);

    fp1 = fopen(filename, "w");
    fprintf(fp1, "%s,", "sl.no");
    fprintf(fp1, "%s,", "payload_length");
    fprintf(fp1, "%s \n", "commulative_rtt");
    for (int i = 0; i < numPacket; i++)
    {
        char buffer[MAXSIZE];
        memset(buffer, '\0', MAXSIZE);
        int payload_length = m[i % 10];
        printf("Payload length made as:%d\n", payload_length);
        int ttl = atoi(argv[3]);
        if (ttl % 2 != 0)
            ttl = ttl - 1;

        cout <<"ttl as: "<< ttl << endl;
        // making payload with random alphabets
        char payload[payload_length + 1];
        for (int j = 0; j < payload_length; j++)
        {
            payload[j] = 'a' + rand() % 26;
        }
        payload[payload_length] = '\0';

        gettimeofday(&timestamp, NULL);
        long int microseconds = timestamp.tv_usec;
        if (i <= 9)
        {
            buffer[0] = '0';
```

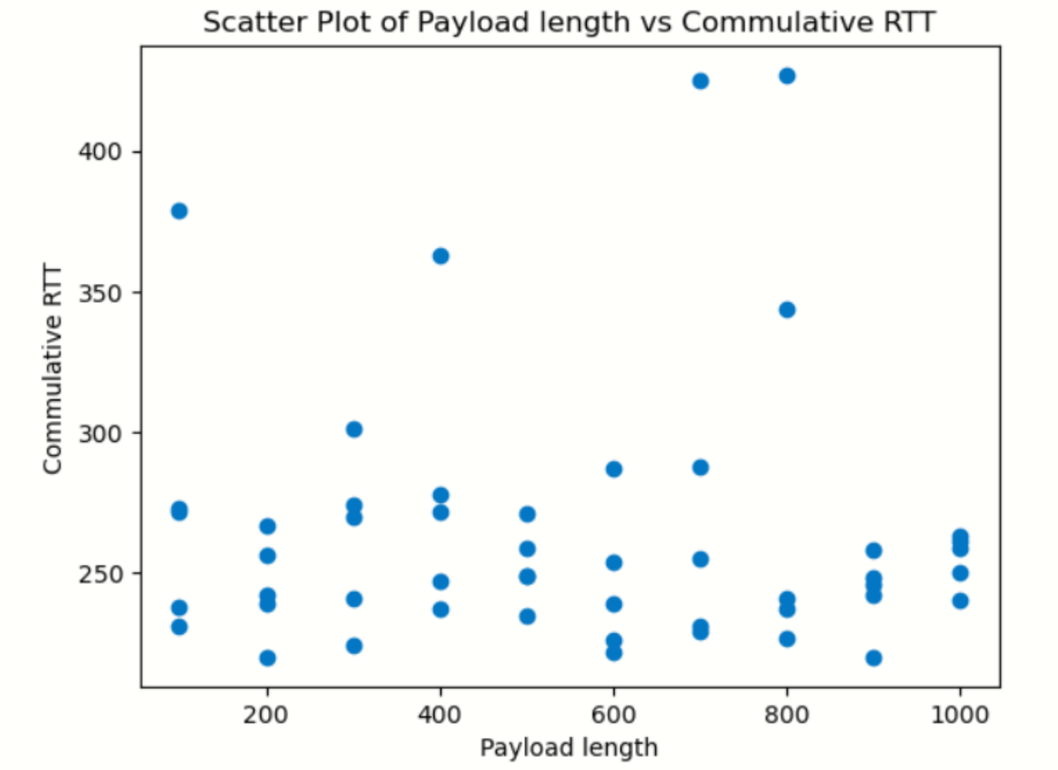
```
            snprintf(buffer + 1, MAXSIZE, "%d%ld", i, microseconds); // i and
microseconds variables, formatting them into a string using the specified
format string, and then writing that string to the buffer starting at the
second position of the buffer
        }
        else
            snprintf(buffer, MAXSIZE, "%d%ld", i, microseconds);

        buffer[8] = ttl;
        buffer[9] = payload_length;


        strcat(buffer, payload);
        strcat(buffer, filename);
        int n;
        while (ttl)
        {
            sendto(sockfd, (const char *)buffer, strlen(buffer),
                   MSG_CONFIRM, (const struct sockaddr *)&servaddr,
                   sizeof(servaddr));
            std::cout << "Client:  "
                      << "Sequence Number:" << buffer[0] << buffer[1] <<
std::endl
                      << "time:" << microseconds << std::endl
                      << "ttl:" << ttl << std::endl;
            std::cout << "above message sent\n";
            n = recvfrom(sockfd, (char *)buffer, MAXSIZE,
                         MSG_WAITALL, (struct sockaddr *)&servaddr,
                         &len);
            ttl = buffer[8];
            ttl--;
            buffer[8] = ttl;
        }

        gettimeofday(&timestamp1, NULL);
        long int microsecond = timestamp1.tv_usec;// gives the time in
microseconds
        ttl = buffer[8];
        buffer[n] = '\0';


        int commulative_rtt = microsecond - microseconds;
        cout << "Starting time is:" << microseconds <<" microseconds"<< endl;
        cout << "ending time is:" << microsecond <<" microseconds"<< endl;
        cout << "This is the commulative rtt-->" << commulative_rtt <<"
microseconds"<< endl;

        vec1.push_back(payload_length);
```

```
        vec2.push_back(commulative_rtt);

        char temp1[5];
        char temp2[5];

        fprintf(fp1, "%d,", i);
        fprintf(fp1, "%d,", payload_length);
        fprintf(fp1, "%d \n", commulative_rtt);
    }
    for (auto it : vec1)
    {
        cout << it << " ";
    }
    cout << endl;
    for (auto it1 : vec2)
    {
        cout << it1 << " ";
    }

    int err = close(sockfd);
    return 0;
}
```

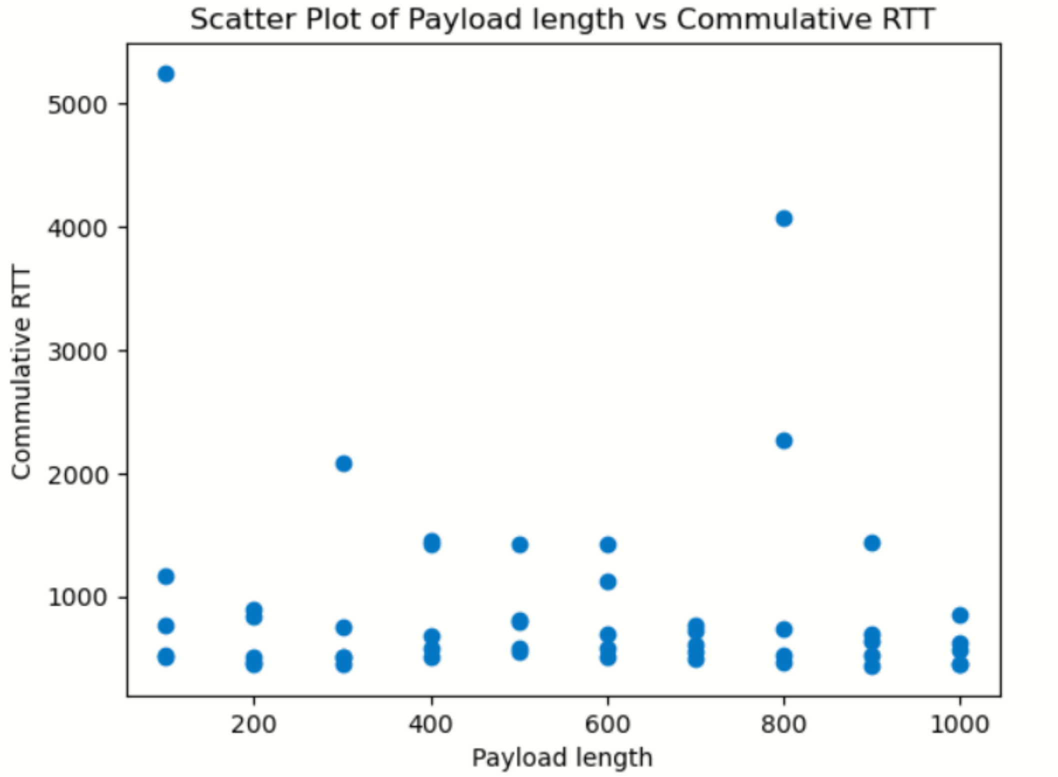
Scatter plot for ttl=2



Scatter Plot for ttl=8



Scatter Plot for ttl= 16



1. Increasing the TTL value from 2 to 8 will allow packets to traverse a greater number of routers or hops before being discarded. This means that packets can travel over a longer distance and may take a longer time to reach their destination.
2. As for the effect on Round-Trip Time (RTT), it may increase or decrease depending on the network conditions. If the network is congested or has a high latency, increasing the TTL value may result in a longer RTT as packets take longer to reach their destination. On the other hand, if the network is not congested and has low latency, increasing the TTL value may have little effect on the RTT.
3. Increasing the TTL value from 8 to 16 will allow packets to traverse a greater number of routers or hops before being discarded. This means that packets can travel over a longer distance and may take a longer time to reach their destination.
4. As for the effect on Round-Trip Time (RTT), it may increase or decrease depending on the network conditions. If the network is congested or has a high latency, increasing the TTL value may result in a longer RTT as packets take longer to reach their destination. On the other hand, if the network is not congested and has low latency, increasing the TTL value may have little effect on the RTT.
5. In general, the effect of changing the TTL value on RTT will depend on various factors, including the network topology, congestion levels, and the distance between the source and destination hosts. However, increasing the TTL value from 8 to 16 is likely to have a smaller impact on RTT than increasing it from 2 to 8 because the number of additional hops that packets can travel is relatively smaller.

Note:

A graph between TTL and RTT can help visualize the relationship between the two. The X-axis represents the TTL value, and the Y-axis represents the corresponding RTT for that TTL value. The graph typically shows a curve where the RTT increases as the TTL value increases.

The slope of the line connecting the data points on the graph signifies the rate at which the RTT is changing with respect to the TTL value. A steeper slope indicates that the RTT is increasing rapidly as the TTL value increases, while a flatter slope indicates that the RTT is increasing slowly.

In general, a steep slope indicates that the network has a high latency, and packets take longer to travel between routers or hops. This could be due to congestion or other factors that slow down the network. A flatter slope, on the other hand, indicates that the network has a low latency and packets travel quickly between routers or hops.

It's important to note that the slope of the graph can vary depending on the network conditions, such as the network topology, congestion levels, and distance between the source and destination hosts. Therefore, the slope alone cannot provide a definitive interpretation of the network conditions, but it can be a useful indicator of the overall trend in the data.