MOBILE COMPUTING
(INITC17)
Practical File

Branch: ITNS

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PRACTICAL 1

AIM: Write the steps to install MATLAB with flowchart

Step 1: MATLAB Installation File

Visit the MathWorks website www.mathworks.com and log in using your MathWorks account.

After logging in, navigate to the MATLAB product page and locate the download link for MATLAB R2023b.

Step 2: Run the Installation File

Run the installation file.

Step 3: Log in with Your MathWorks Account

Login using your Id.

Step 4: Accept the License Agreement

Accept the MathWorks Software License.

Step 5: Select Your License

Review the license details and click "Next" to continue with the installation.

Step 6: Select Destination Folder

Choose the folder where you want MATLAB to be installed. The default installation path is usually recommended. Click "Next" to move on.

Step 7: Select Products to Install

Select which MATLAB products you want to install. Select "MATLAB" and "Simulink.

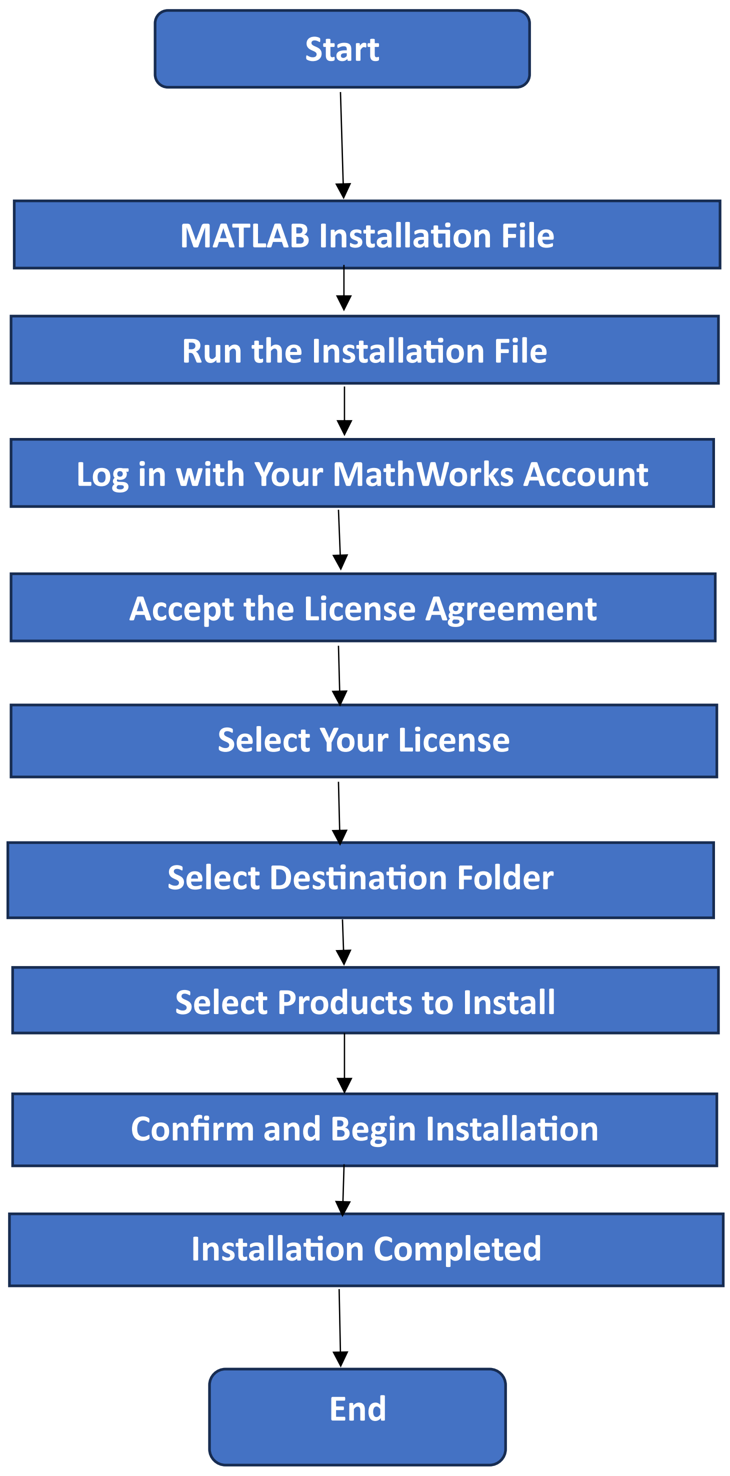
Step 8: Confirm and Begin Installation

Review your selections. If everything is fine, click "Next" to start the installation process.

Step 9: Installation Completed

MATLAB R2023b is now installed on your Windows system.

Flowchart


Start
MATLAB Installation File
Run the Installation File
Log in with Your MathWorks Account
Accept the License Agreement
Select Your License
Select Destination Folder
Select Products to Install
Confirm and Begin Installation
Installation Completed
End

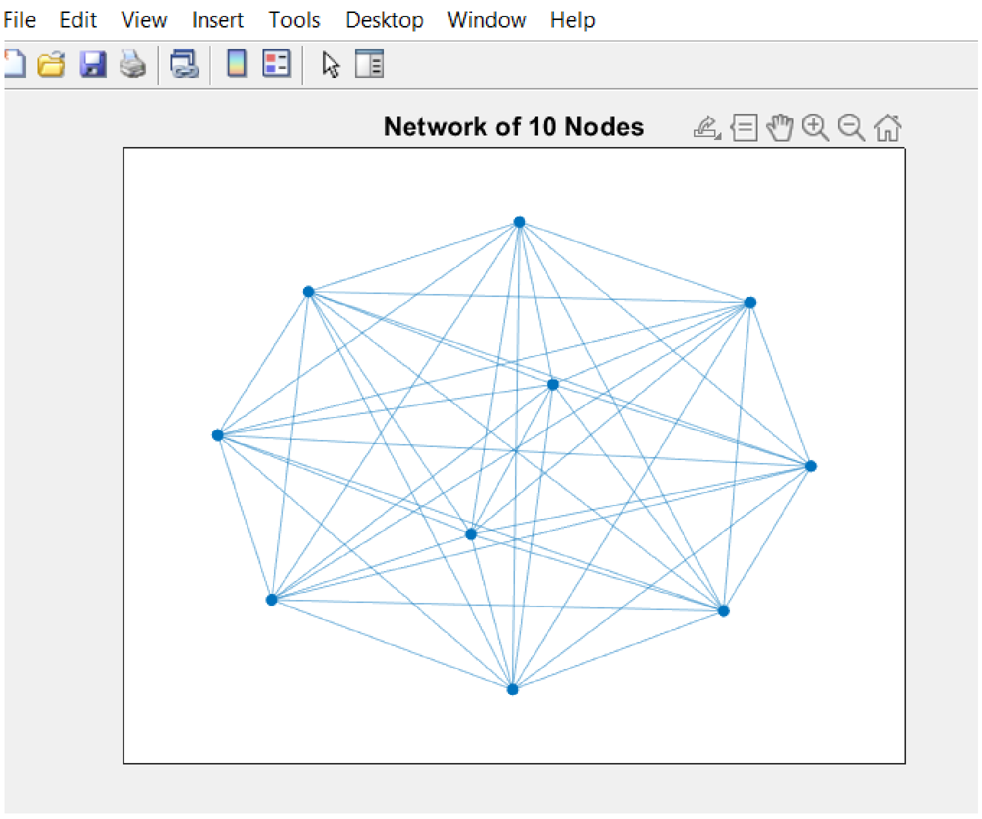
PRACTICAL 2

AIM : Write the program in MATLAB to implement network of 10 nodes

Code

```
numNodes = 10;

G = graph(rand(numNodes), 'upper', 'omitselfloops');

figure;

plot(G, 'NodeLabel', {});

title('Network of 10 Nodes');
```

Output



PRACTICAL 3

AIM : Implement a point-to-point network consisting of 10 nodes using MATLAB with duplex links between them. Initiate a communication between these nodes. Set the queue size, vary the bandwidth and find the number of packets dropped. Finally plot the graph showing the performance of this network in terms of number of packets dropped with varying bandwidth.

Network Assumptions

All 10 nodes have equal bandwidth.

All nodes have a constant queue size

Constant packet size, and packet arrival time of 1 ms.

Constants

queue_size = 50;

bandwidth = 16;

packet_size = 2000;

max_packet_size = 1000;

stop_time = 1100;

arrival_time = 1e-3;

propagation_delay = 5e-3;

Data Collection and Analysis

Packet drop ideally occurs only at Node 0, as for all other nodes, inRate equals outRate. The program initializes

arrays to store bandwidth and packets dropped, as well as inRates, outRates, and transmissionDelays. It then

iterates through varying bandwidth values, calculating transmission delays, inRates, outRates, and packet drops.

Results are stored in arrays and printed for analysis.

```
bandwidth_values = [];

packets_dropped = [];

inRates = [];

outRates = [];

transmissionDelays = [];

while bandwidth >= 1

        transmission_delay = (max_packet_size * 8) / (bandwidth * 1e6);

        inRate = packet_size / max_packet_size;

        outRate = 1e-3 / transmission_delay;

        if inRate <= outrate

                PacketsDropped = 0;
        else

                firstDrop = queue_size / (inRate - outRate);

                PacketsDropped = ceil((stop_time - firstDrop) * (inRate - outRate)) + 1;

end

bandwidth_values = [bandwidth_values, bandwidth];

packets_dropped = [packets_dropped, PacketsDropped];

inRates = [inRates, inRate];

outRates = [outRates, outRate];

transmissionDelays = [transmissionDelays, transmission_delay];

fprintf('Bandwidth: %.2f bps\n', bandwidth);

fprintf('InRate: %.2f\n', inRate);

fprintf('OutRate: %.2f\n', outRate);

fprintf('Transmission Delay: %.6f s\n', transmission_delay);

fprintf('Packets Dropped: %d\n\n', PacketsDropped);

bandwidth = bandwidth / 2;
```

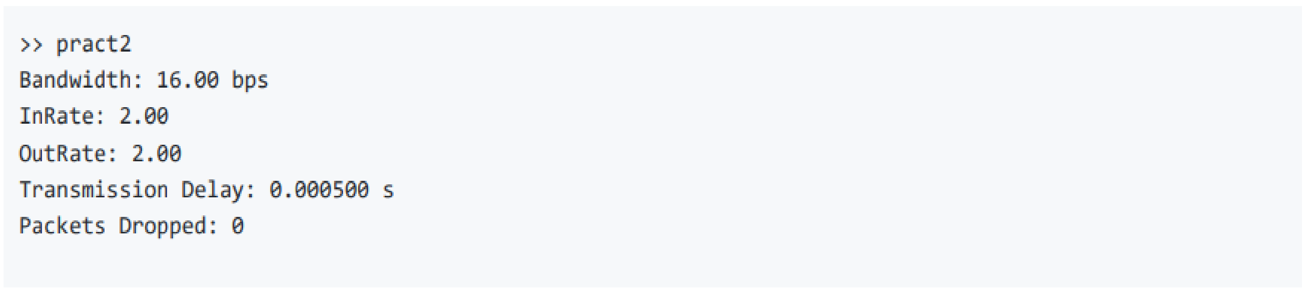
Data Visualization

The program plots a graph showing the relationship between bandwidth and packets dropped. Text annotations

are added to the graph to display the values of bandwidth and packets dropped for each data point.

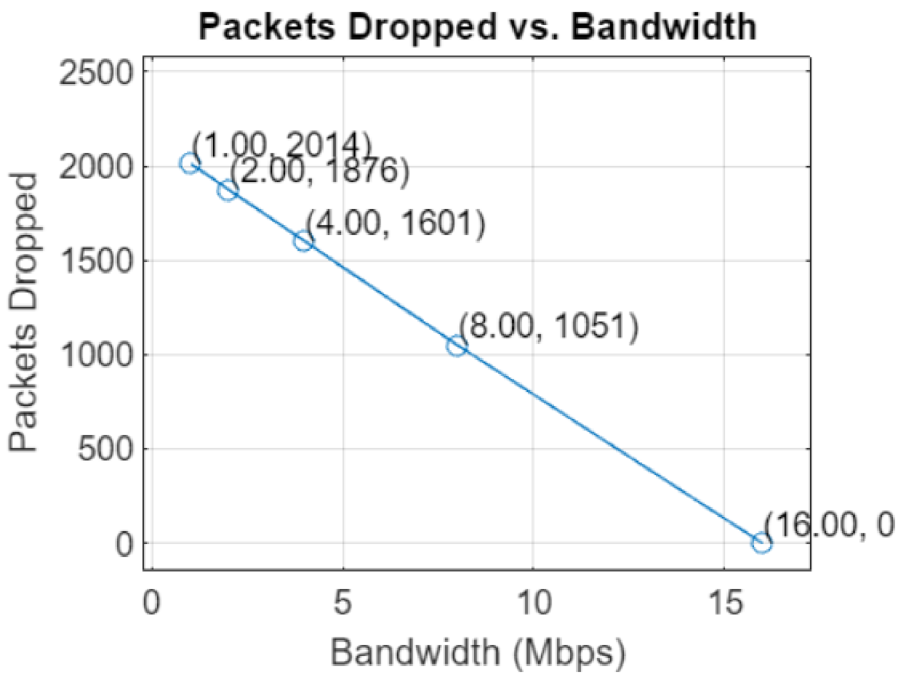
```
plot(bandwidth_values, packets_dropped, '-o');
xlabel('Bandwidth (Mbps)');
ylabel('Packets Dropped');
title('Packets Dropped vs. Bandwidth');
grid on;
for i = 1:length(bandwidth_values)
        x = bandwidth_values(i);
        y = packets_dropped(i);
        text(x, y, sprintf('(%.2f, %d)', x, y), 'VerticalAlignment', 'bottom', 'HorizontalAlignment', 'left')
end
```

Output



```
>> pract2
Bandwidth: 16.00 bps
InRate: 2.00
OutRate: 2.00
Transmission Delay: 0.000500 s
Packets Dropped: 0
```

```
Bandwidth: 8.00 bps
InRate: 2.00
OutRate: 1.00
Transmission Delay: 0.001000 s
Packets Dropped: 1051

Bandwidth: 4.00 bps
InRate: 2.00
OutRate: 0.50
Transmission Delay: 0.002000 s
Packets Dropped: 1601

Bandwidth: 2.00 bps
InRate: 2.00
OutRate: 0.25
Transmission Delay: 0.004000 s
Packets Dropped: 1876

Bandwidth: 1.00 bps
InRate: 2.00
OutRate: 0.12
Transmission Delay: 0.008000 s
Packets Dropped: 2014
```

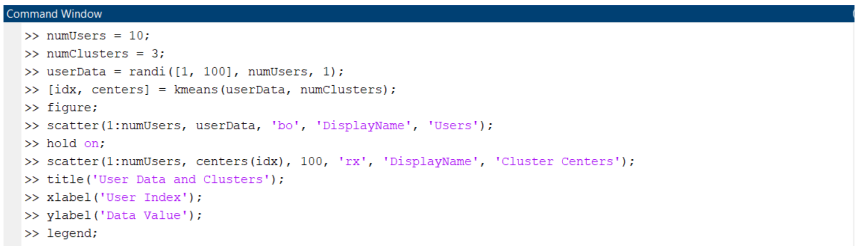


PRACTICAL 4

AIM : Implementation of FDMA, TDMA and CDMA using MATLAB

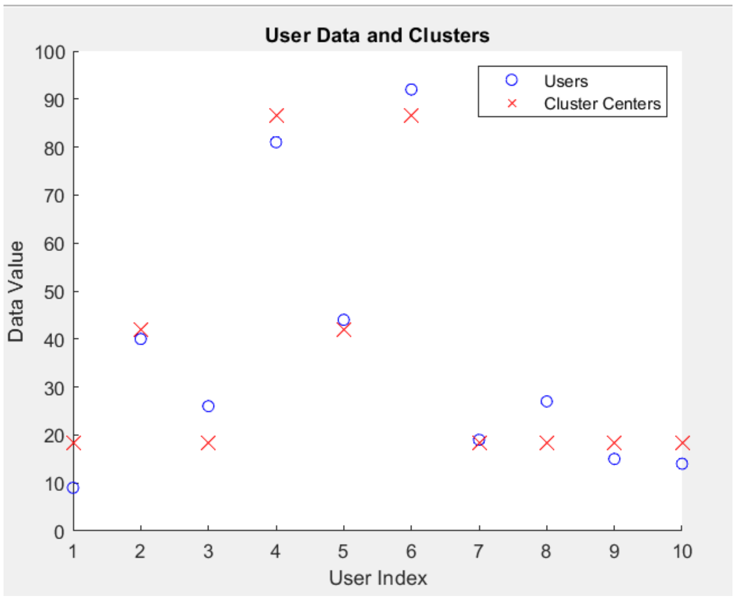
Code

```
numUsers = 10;
numClusters = 3;
userData = randi([1, 100], numUsers, 1);
[idx, centers] = kmeans(userData, numClusters);
figure;
scatter(1:numUsers, userData, 'bo', 'DisplayName', 'Users');
hold on;
scatter(1:numUsers, centers(idx), 100, 'rx', 'DisplayName', 'Cluster Centers');
title('User Data and Clusters');
xlabel('User Index');
ylabel('Data Value');
legend;
```



Command Window

```
>> numUsers = 10;
>> numClusters = 3;
>> userData = randi([1, 100], numUsers, 1);
>> [idx, centers] = kmeans(userData, numClusters);
>> figure;
>> scatter(1:numUsers, userData, 'bo', 'DisplayName', 'Users');
>> hold on;
>> scatter(1:numUsers, centers(idx), 100, 'rx', 'DisplayName', 'Cluster Centers');
>> title('User Data and Clusters');
>> xlabel('User Index');
>> ylabel('Data Value');
>> legend;
```



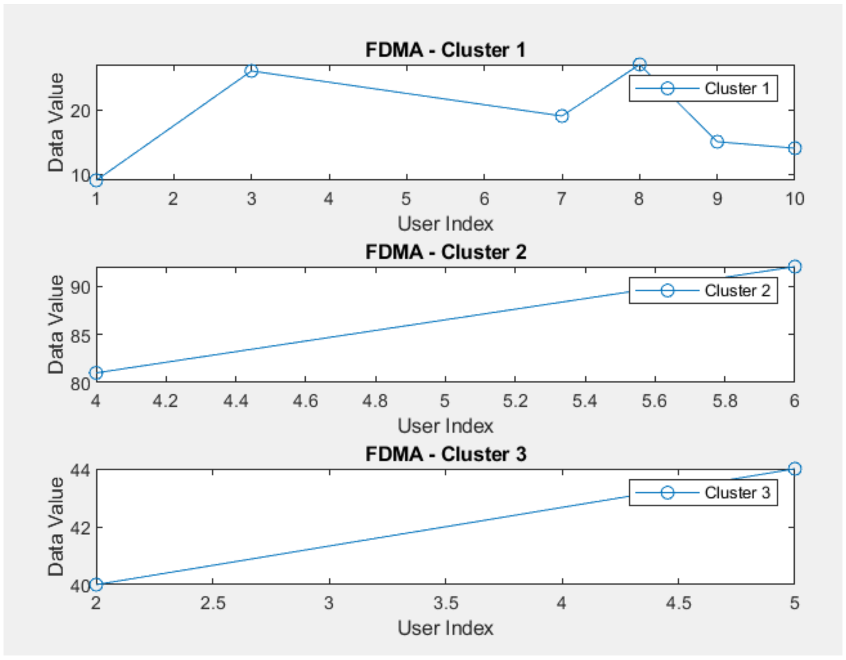
Frequency Division Multiple Access (FDMA)

Code

```
figure;
for i = 1:numClusters
    subplot(numClusters, 1, i);
    usersInCluster = find(idx == i);
    plot(usersInCluster, userData(usersInCluster), 'o-', 'DisplayName',
sprintf('Cluster %d', i));
    title(sprintf('FDMA - Cluster %d', i));
    xlabel('User Index');
    ylabel('Data Value');
    legend;
 end
```

```
>> % Frequency Division Multiple Access (FDMA)
>> figure;
>> for i = 1:numClusters
       subplot(numClusters, 1, i);
       usersInCluster = find(idx == i);
       plot(usersInCluster, userData(usersInCluster), 'o-', 'DisplayName', sprintf('Cluster %d', i));
       title(sprintf('FDMA - Cluster %d', i));
       xlabel('User Index');
       ylabel('Data Value');
       legend;
   end
>>
```

Output



Time Division Multiple Access (TDMA)

Code

figure;

for i = 1:numClusters

    subplot(numClusters, 1, i);

    usersInCluster = find(idx == i);

    timeSlots = 1:length(usersInCluster);

    plot(timeSlots, userData(usersInCluster), 'o-', 'DisplayName', sprintf('Cluster %d', i));

    title(sprintf('TDMA - Cluster %d', i));

    xlabel('Time Slot');

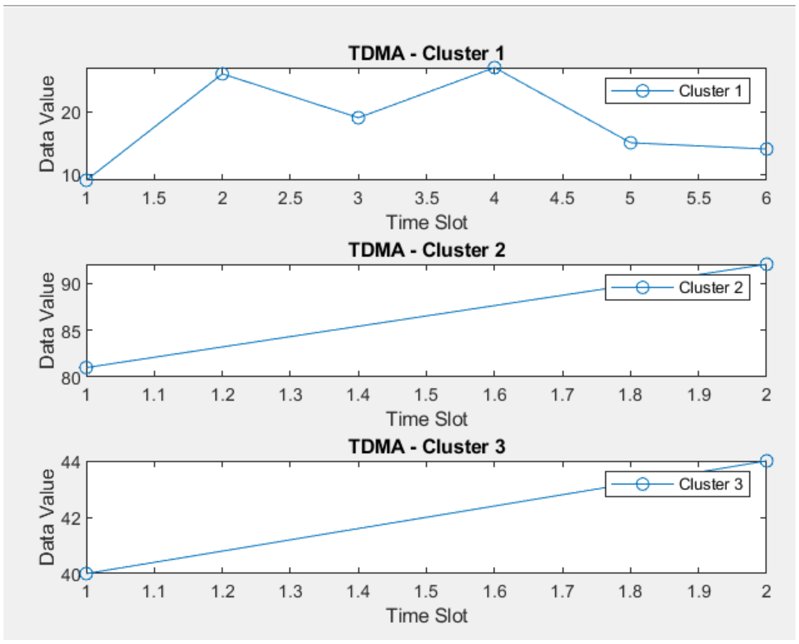
    ylabel('Data Value');

    legend;

end

```
>> % Time Division Multiple Access (TDMA)
>> figure;
>> for i = 1:numClusters
       subplot(numClusters, 1, i);
       usersInCluster = find(idx == i);
       timeSlots = 1:length(usersInCluster);
       plot(timeSlots, userData(usersInCluster), 'o-', 'DisplayName', sprintf('Cluster %d', i));

       title(sprintf('TDMA - Cluster %d', i));
       xlabel('Time Slot');
       ylabel('Data Value');
       legend;
   end
```

Output



Code Division Multiple Access (CDMA)

Code

figure;

spreadCodes = randi([0, 1], numUsers, numUsers);

cdmaData = spreadCodes * userData;

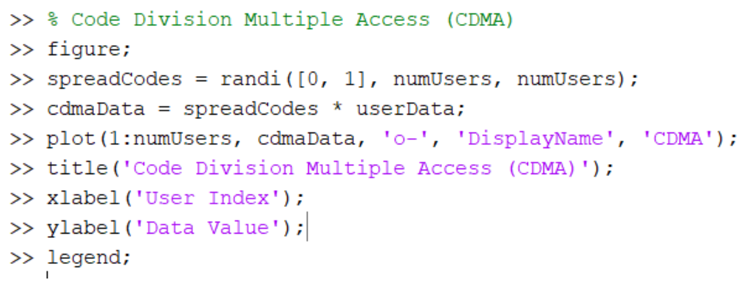
plot(1:numUsers, cdmaData, 'o-', 'DisplayName', 'CDMA');

title('Code Division Multiple Access (CDMA)');

xlabel('User Index');

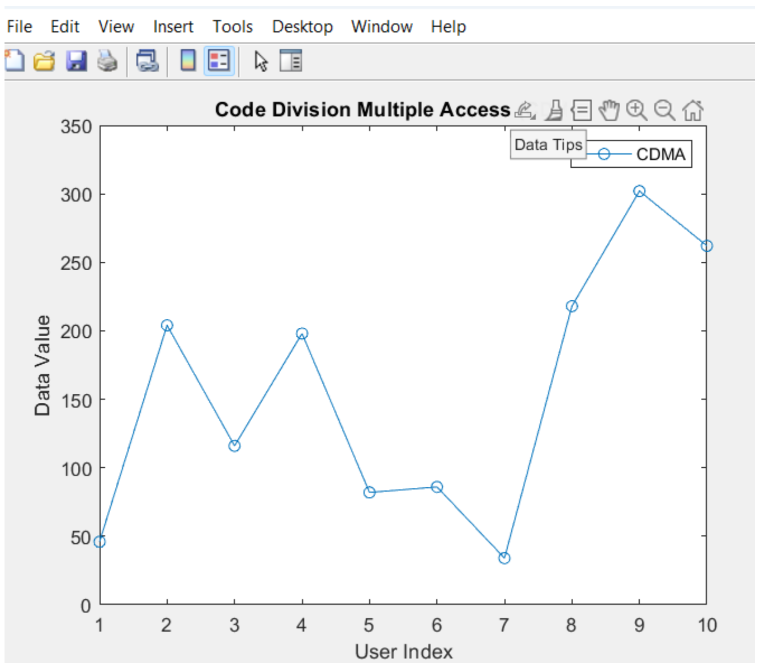
ylabel('Data Value');

legend;



```
>> % Code Division Multiple Access (CDMA)
>> figure;
>> spreadCodes = randi([0, 1], numUsers, numUsers);
>> cdmaData = spreadCodes * userData;
>> plot(1:numUsers, cdmaData, 'o-', 'DisplayName', 'CDMA');
>> title('Code Division Multiple Access (CDMA)');
>> xlabel('User Index');
>> ylabel('Data Value');
>> legend;
```

Output



PRACTICAL 5

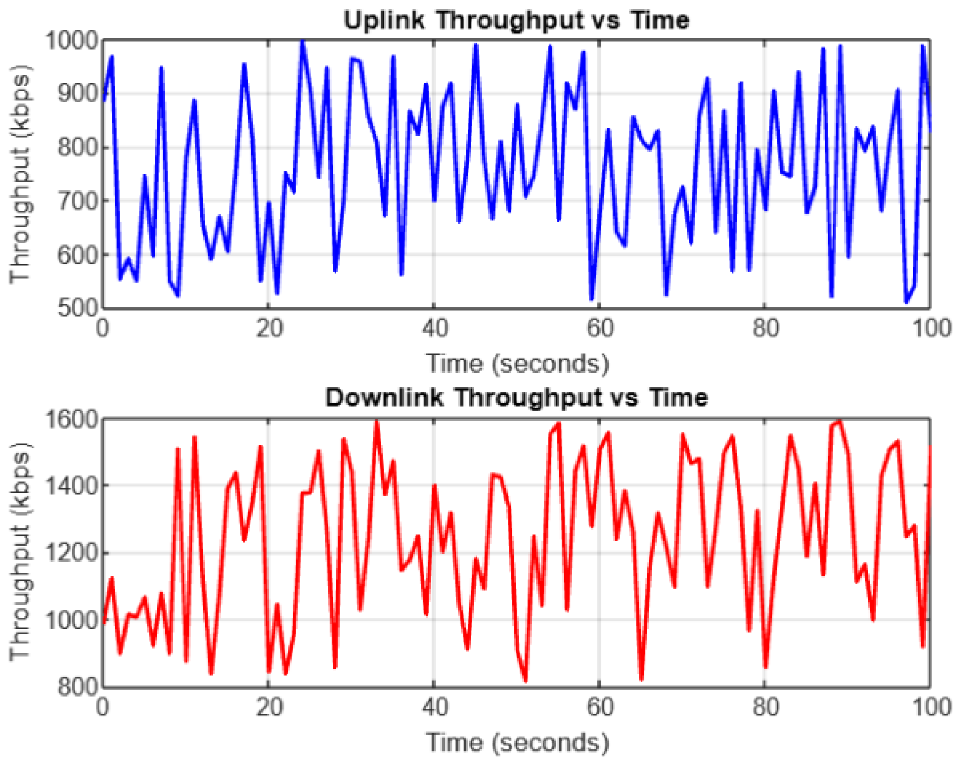
AIM : Implement GSM using MATLAB

CODE

```
% Parameters
total_time = 100; % Total simulation time (in seconds)
time_interval = 1; % Time interval for calculation (in seconds)
% Simulation
time = 0:time_interval:total_time;
num_intervals = numel(time);
% Generating example throughput values (random in this case)
uplink_throughput = rand(1, num_intervals)*500 + 500; %
Random values between
500 and 1000 kbps
downlink_throughput = rand(1, num_intervals)*800 + 800; %
Random values between
800 and 1600 kbps
% Creating subplots for uplink and downlink
figure;
% Subplot for uplink throughput
subplot(2, 1, 1);
plot(time, uplink_throughput, 'b', 'LineWidth', 1.5);
title('Uplink Throughput vs Time');
xlabel('Time (seconds)');
```

```
ylabel('Throughput (kbps)');
grid on;
% Subplot for downlink throughput
subplot(2, 1, 2);
plot(time, downlink_throughput, 'r', 'LineWidth', 1.5);
title('Downlink Throughput vs Time');
xlabel('Time (seconds)');
ylabel('Throughput (kbps)');
grid on
```

OUTPUT

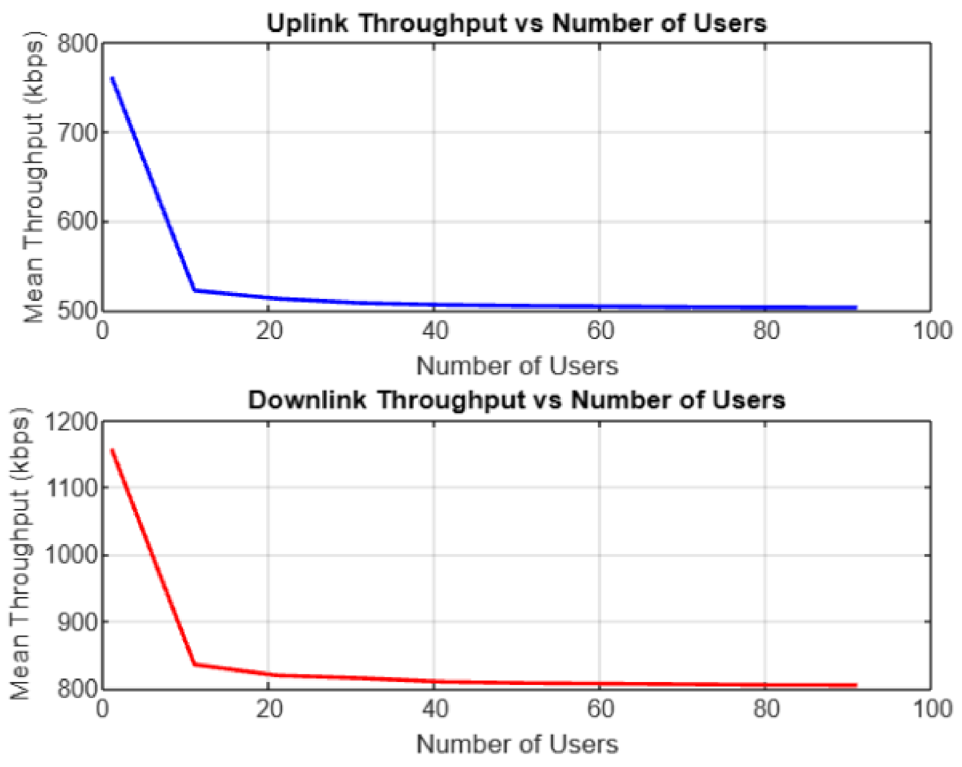


MATLAB Code for GSM (Throughput vs Number Of Users):

```
total_time = 100; % Total simulation time (in seconds)
time_interval = 1; % Time interval for calculation (in seconds)
num_users = 1:10:100; % Varying number of users
% Pre-allocating arrays for throughput
uplink_throughput = zeros(length(num_users), total_time);
downlink_throughput = zeros(length(num_users), total_time);
% Simulating throughput for different numbers of users
for i = 1:length(num_users)
 % Generating example throughput values (decreasing with more users for
demonstration purposes)
 uplink_throughput(i, :) = rand(1, total_time) * (500 / num_users(i)) + 500;
 downlink_throughput(i, :) = rand(1, total_time) * (800 / num_users(i)) + 800;
end
% Plotting the change in throughput with the number of users in separate
subplots
figure;
% Subplot for uplink throughput
subplot(2, 1, 1);
plot(num_users, mean(uplink_throughput, 2), 'b', 'LineWidth', 1.5);
title('Uplink Throughput vs Number of Users');
xlabel('Number of Users');
ylabel('Mean Throughput (kbps)');
grid on;
% Subplot for downlink throughput
```

```
subplot(2, 1, 2);

plot(num_users, mean(downlink_throughput, 2), 'r', 'LineWidth', 1.5);

title('Downlink Throughput vs Number of Users');

xlabel('Number of Users');

ylabel('Mean Throughput (kbps)');

grid on;
```

OUTPUT



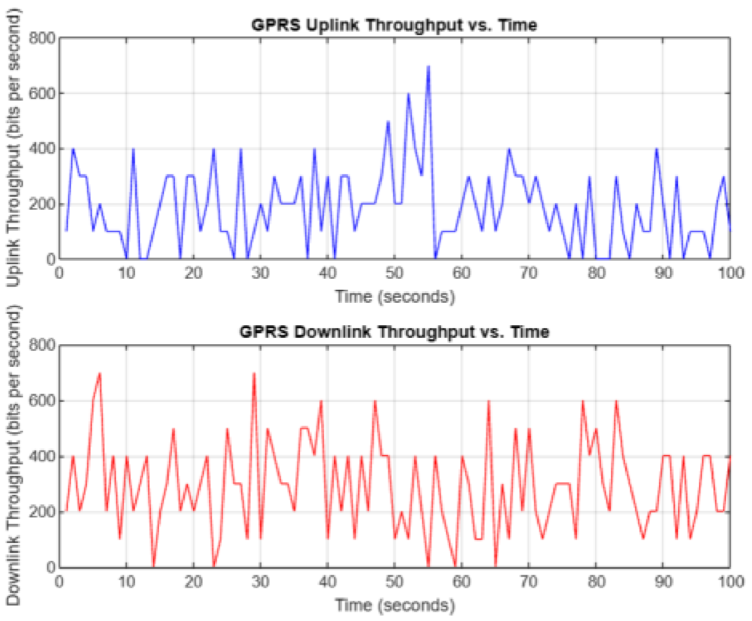
PRACTICAL 6

AIM : MATLAB Code for GPRS using MAC Layer

CODE

```
% Simulation parameters
simulation_duration = 100; % Duration of the simulation in seconds
packet_rate_uplink = 2; % Uplink packets per second
packet_rate_downlink = 3; % Downlink packets per second
packet_size = 100; % Packet size in bits
% Initialize variables
time = 0;
throughput_uplink = zeros(1, simulation_duration);
throughput_downlink = zeros(1, simulation_duration);
% Simulation loop
for t = 1:simulation_duration
 % Generate random uplink and downlink packets
 num_packets_uplink = poissrnd(packet_rate_uplink);
 num_packets_downlink = poissrnd(packet_rate_downlink);

 total_bits_transferred_uplink = num_packets_uplink * packet_size;
 total_bits_transferred_downlink = num_packets_downlink * packet_size;

 % Update uplink and downlink throughputs
 throughput_uplink(t) = total_bits_transferred_uplink;
 throughput_downlink(t) = total_bits_transferred_downlink;

 % Update time
 time = time + 1;
end
% Plot uplink throughput vs. time
figure;
subplot(2, 1, 1);
plot(1:simulation_duration, throughput_uplink, 'b-');
xlabel('Time (seconds)');
ylabel('Uplink Throughput (bits per second)');
title('GPRS Uplink Throughput vs. Time');
grid on;
% Plot downlink throughput vs. time
subplot(2, 1, 2);
plot(1:simulation_duration, throughput_downlink, 'r-');
xlabel('Time (seconds)');
ylabel('Downlink Throughput (bits per second)');
title('GPRS Downlink Throughput vs. Time');
grid on;
```

OUTPUT



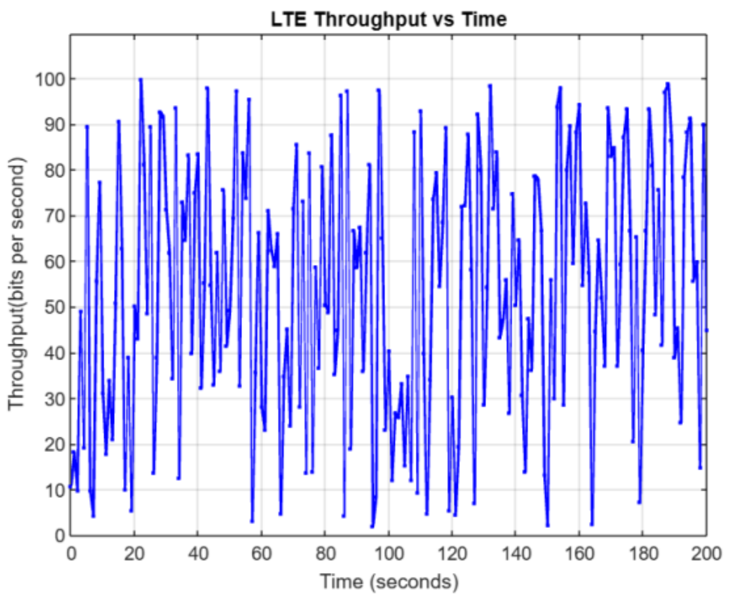
Practical 7

AIM : Implement LTE using MATLAB

MATLAB Code for LTE(Throughput vs Time):

```
% Constants for simulation
total_time = 200; % Total simulation time (in seconds) - 1 hour
packet_duration = 1; % Duration of each packet transmission (in seconds)
% Initialize variables
time = 0:packet_duration:total_time; % Time vector
num_packets = length(time); % Number of packets
% Simulate random throughput values for LTE over time
throughput = rand(1, num_packets) * 100; % Generating random throughput
values (scaled
by 100 for example purposes)
% Plot throughput vs time for LTE
figure;
plot(time, throughput, 'b.-', 'LineWidth', 1.5);
title('LTE Throughput vs Time');
xlabel('Time (seconds)');
ylabel('Throughput(bits per second)');
grid on;
```

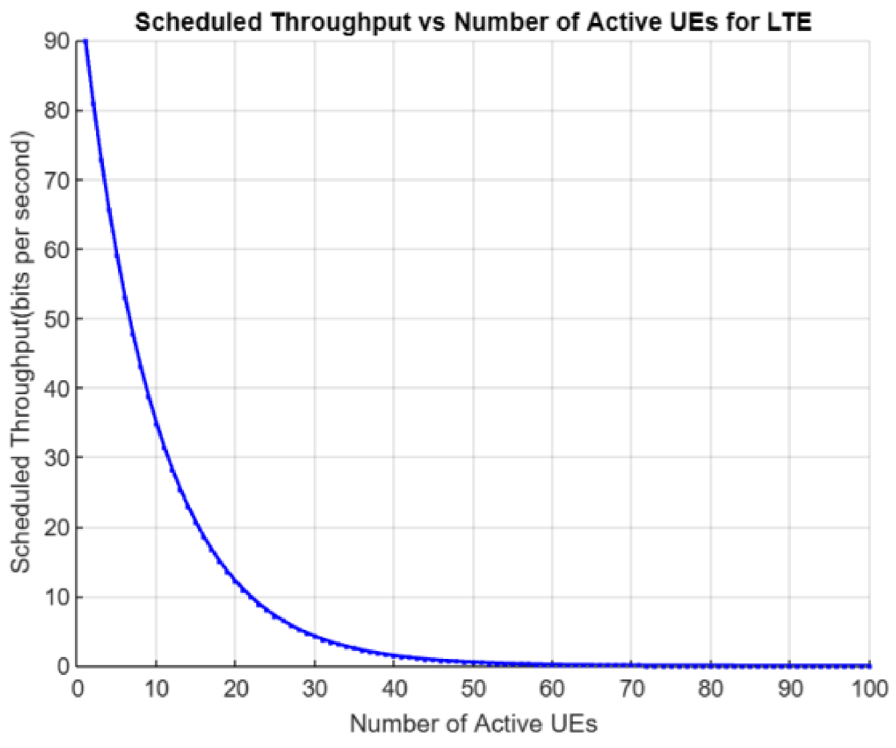
OUTPUT



MATLAB Code for LTE(Throughput vs Number Of Users):

```
% Constants for simulation

total_time = 3600; % Total simulation time (in seconds) - 1 hour

packet_duration = 1; % Duration of each packet transmission (in seconds)

max_UEs = 100; % Maximum number of UEs to simulate

% Initialize variables

num_UEs = 1:max_UEs; % Varying number of active UEs

scheduled_throughput = zeros(1, max_UEs); % Initialize array for scheduled
throughput

for i = 1:max_UEs

 % Simulate scheduled throughput for each number of UEs

 % For this example, assume scheduled throughput decreases with more UEs

 num_active_UEs = num_UEs(i);

 % Simulate decreasing throughput values for each number of UEs

 initial_throughput = 100; % Initial throughput value
 decreasing_factor = 0.9; % Factor for decreasing throughput
 scheduled_throughput(i) = initial_throughput *
decreasing_factor^num_active_UEs;
end
% Plot scheduled throughput against number of active UEs
figure;
hold on;
grid on;
plot(num_UEs, scheduled_throughput, 'b.-', 'LineWidth', 1.5);
title('Scheduled Throughput vs Number of Active UEs for LTE');
xlabel('Number of Active UEs');
ylabel('Scheduled Throughput(bits per second)');
```

OUTPUT



Practical-8

AIM : IMPLEMENT SNOOPING AND ANALYSING THE TRAFFIC USING WIRESHARK

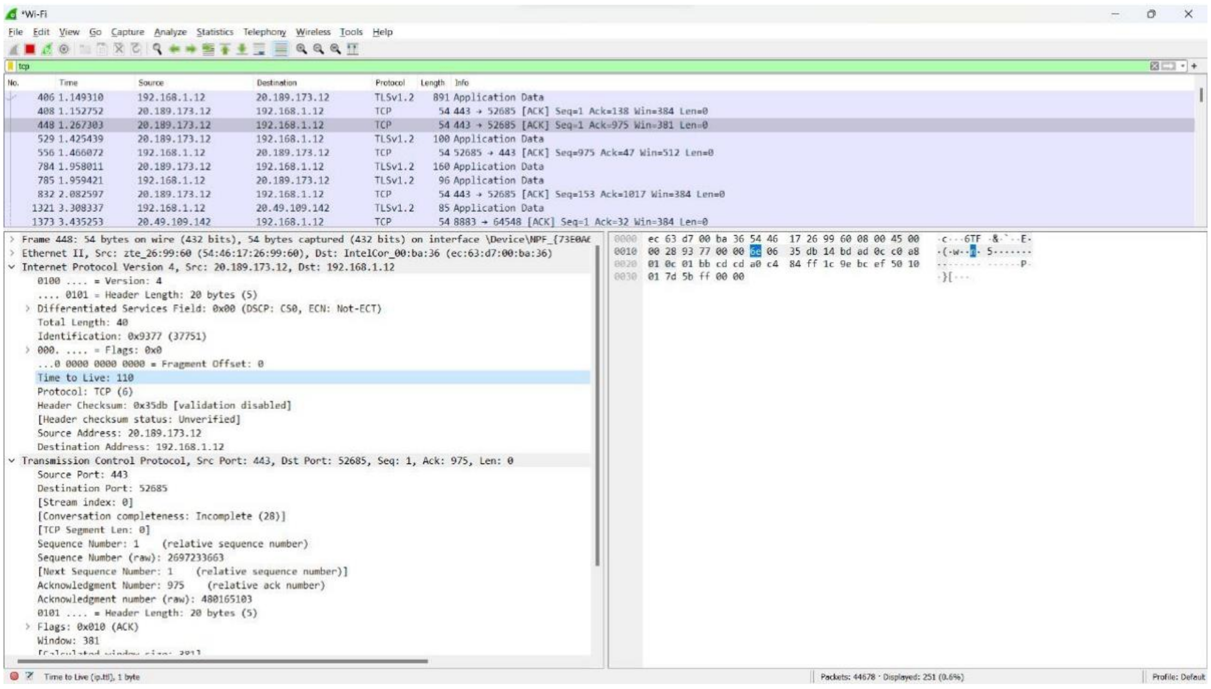
Launch Wireshark:
Start Wireshark with administrative privileges, especially if you're using Windows or need to capture traffic on certain interfaces.

Select the Network Interface:
In Wireshark, select the network interface you want to capture traffic from. This could be your Wi-Fi or Ethernet connection.

Start Capturing:
Click on the "Start" or "Capture" button to begin capturing network traffic.

Stop Capturing:
Once you've captured the desired traffic, click the "Stop" or "Capture" button to stop the capture.

Analyze the Traffic:
You can now analyze the captured traffic. You can look at individual requests and responses, examine the headers, see the content, and much more



*Wi-Fi
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp

```
No.   Time      Source          Destination     Protocol Length Info
  406 1.149310  192.168.1.12    20.189.173.12   TLSv1.2   891 Application Data
  408 1.152752  20.189.173.12   192.168.1.12    TCP        54 443 → 52685 [ACK] Seq=1 Ack=138 Win=384 Len=0
  448 1.267303  20.189.173.12   192.168.1.12    TCP        54 443 → 52685 [ACK] Seq=1 Ack=975 Win=381 Len=0
  529 1.425439  20.189.173.12   192.168.1.12    TLSv1.2   100 Application Data
  556 1.466072  192.168.1.12    20.189.173.12   TCP        54 52685 → 443 [ACK] Seq=975 Ack=47 Win=512 Len=0
  784 1.958011  20.189.173.12   192.168.1.12    TLSv1.2   160 Application Data
  785 1.959421  192.168.1.12    20.189.173.12   TLSv1.2    96 Application Data
  832 2.082597  20.189.173.12   192.168.1.12    TCP        54 443 → 52685 [ACK] Seq=153 Ack=1017 Win=384 Len=0
 1321 3.308337  192.168.1.12    20.49.109.142   TLSv1.2    85 Application Data
 1373 3.435253  20.49.109.142   192.168.1.12    TCP        54 8883 → 64548 [ACK] Seq=1 Ack=32 Win=384 Len=0
```

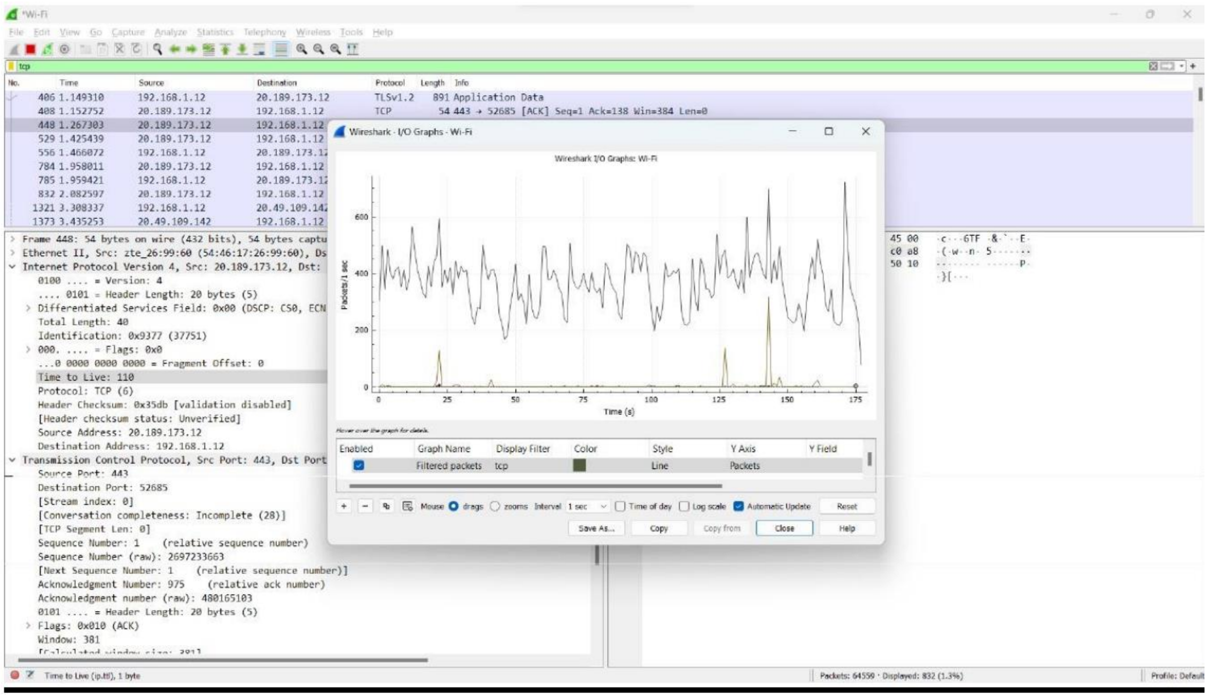
```
> Frame 448: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface \Device\NPF_{73E0A€
> Ethernet II, Src: zte_26:99:60 (54:46:17:26:99:60), Dst: IntelCor_00:ba:36 (ec:63:d7:00:ba:36)
v Internet Protocol Version 4, Src: 20.189.173.12, Dst: 192.168.1.12
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 40
    Identification: 0x9377 (37751)
  > 000. .... = Flags: 0x0
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 110
    Protocol: TCP (6)
    Header Checksum: 0x35db [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 20.189.173.12
    Destination Address: 192.168.1.12
v Transmission Control Protocol, Src Port: 443, Dst Port: 52685, Seq: 1, Ack: 975, Len: 0
    Source Port: 443
    Destination Port: 52685
    [Stream index: 0]
    [Conversation completeness: Incomplete (28)]
    [TCP Segment Len: 0]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 2697233663
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 975    (relative ack number)
    Acknowledgment number (raw): 480165103
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
    Window: 381
```

```
0000  ec 63 d7 00 ba 36 54 46  17 26 99 60 08 00 45 00   ·c···6TF ·&·`··E·
0010  00 28 93 77 00 00 6e 06  35 db 14 bd ad 0c c0 a8   ·(·w··n· 5·······
0020  01 0c 01 bb cd cd a0 c4  84 ff 1c 9e bc ef 50 10   ········ ······P·
0030  01 7d 5b ff 00 00                                  ·}[···
```

Time to Live (ip.ttl), 1 byte

Packets: 44678 · Displayed: 251 (0.6%)

Profile: Default



Enabled	Graph Name	Display Filter	Color	Style	Y Axis	Y Field
✓	Filtered packets	tcp	■	Line	Packets	

Interval 1 sec ☐ Time of day ☐ Log scale ☑ Automatic Update

Time to Live (ip.ttl), 1 byte

Packets: 64559 · Displayed: 832 (1.3%)

Profile: Default