

# **Lab Manual**

## **Network Programming Lab**



**Department of Computer Science &  
Engineering**  
**College Of Engineering Cherthala , Alappuzha**

**COLLEGE OF ENGINEERING CHERTHALA, ALAPPUZHA**  
**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**Vision:**

To evolve into a center of excellence in the field of computer science and engineering providing innovative and quality engineers contributing to the society and nation

**Mission:**

To impact high quality professional training with emphasis on state of the art technology in computer science and engineering including professional and ethical values in the young minds

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****PROGRAMME OUTCOMES (POs)**

PO1	Apply the knowledge of mathematics, science and engineering fundamentals to solve complex computer science and engineering related problems.
PO2	Identify, formulate, make literature reviews, and analyze complex computer science and engineering problems to reach substantiated conclusions.
PO3	
PO4	
PO5	
PO6	
PO7	
PO8	
PO9	
PO10	
PO11	
PO12	

Syllabus	5
Course Outcomes	6
Mapping of course outcomes with program outcomes	6
Abstract POs defined by National Board of Accreditation	7
References	8
Getting started with the basics of network configuration files and networking commands in Linux	9
To familiarize and understand the use and functioning of system calls used for network programming in Linux.	12
Implement client-server communication using socket programming and TCP as transport layer protocol	16
Implement client-server communication using socket programming and UDP as transport layer protocol	24
Implementation of a multi user chat server using TCP as transport layer protocol.	29

Implementation of concurrent time server using UDP	35
Simulate sliding window flow control protocols. (Stop and Wait, Go back N, Selective Repeat ARQ protocols)	41
Implement and simulate algorithms for Distance Vector Routing protocol or Link State Routing protocol.	64
Implement Simple Mail Transfer Protocol.	74
Implement File Transfer Protocol.	86
Implement congestion control using a leaky bucket algorithm.	94
Understanding the Wireshark tool.	97
Study of NS2 simulator	106

## Syllabus

### **\*Mandatory List of Exercises/ Experiments**

**(Note: At least one program from each topic in the syllabus should be completed in the Lab)**

1. Getting started with the basics of network configuration files and networking commands in Linux.\*
2. To familiarize and understand the use and functioning of system calls used for network programming in Linux.\*
3. Implement client-server communication using socket programming and TCP as transport layer protocol\*
4. Implement client-server communication using socket programming and UDP as transport layer protocol\*
5. Implementation of a multi user chat server using TCP as transport layer protocol.
6. Implementation of concurrent time server using UDP
7. Simulate sliding window flow control protocols.\* (Stop and Wait, Go back N, Selective Repeat ARQ protocols)

8. Implement and simulate algorithm for Distance Vector Routing protocol or Link State Routing protocol.\*
9. Implement Simple Mail Transfer Protocol.
10. Implement File Transfer Protocol.\*
11. Implement congestion control using a leaky bucket algorithm.\*
12. Understanding the Wireshark tool.\*
13. Study of NS2 simulator\*

## Course Outcomes

CO#	Course Outcomes
CO1	Use network related commands and configuration files in Linux Operating System. (Cognitive Knowledge Level: Understand).
CO2	Develop network application programs and protocols. (Cognitive Knowledge Level: Apply)
CO3	Analyze network traffic using network monitoring tools. (Cognitive Knowledge Level: Apply)
CO4	Design and set up a network and configure different network protocols. (Cognitive Knowledge Level: Apply)
CO5	Develop simulation of fundamental network concepts using a network simulator. (Cognitive Knowledge Level: Apply)

### Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
co1	✓	✓	✓					✓		✓		✓	
co2	✓	✓	✓	✓				✓		✓		✓	
co3	✓	✓	✓	✓	✓			✓		✓		✓	
co4	✓	✓	✓	✓	✓	✓		✓		✓		✓	
co5	✓	✓	✓	✓	✓			✓		✓		✓	

### Abstract POs defined by National Board of Accreditation

po#	Broad PO	po#	Broad PO
po1	Engineering Knowledge	po7	Environment and Sustainability
po2	Problem Analysis	po8	Ethics
po3	Design/Development of solutions	po9	Individual and teamwork
po4	Conduct investigations of complex problems	po10	Communication
po5	Modern tool usage	po11	Project Management and Finance
po6	The Engineer and Society	po12	Lifelong learning

## **Reference Books:**

1. W. Richard Stevens, Bill Fenner, Andy Rudoff, UNIX Network Programming: Volume 1, The Sockets Networking API, 3rd Edition, Pearson, 2015
2. Lisa Bock, Learn Wireshark: Confidently navigate the Wireshark interface and solve real-world networking problems, Packt Publishing, 2019
3. Teerawat Issariyakul, Ekram Hossain, Introduction to Network Simulator NS2, 2nd Edition, Springer, 2019





## Experiment 1

### Getting started with Basics of Network configurations files and Networking

Commands in Linux.

The important network configuration files in Linux operating systems are

#### 1. /etc/hosts

This file is used to resolve hostnames on small networks with no DNS server. This text file contains a mapping of an IP address to the corresponding host name in each line. This file also contains a line specifying the IP address of the loopback device i.e, 127.0.0.1 is mapped to localhost.

A typical hosts file is as shown

```
127.0.0.1 localhost
127.0.1.1 anil-300E4Z-300E5Z-300E7Z
```

#### 2. /etc/resolv.conf

This configuration file contains the IP addresses of DNS servers and the search domain.

A sample file is shown

```
# DO NOT EDIT THIS FILE BY HAND -- YOUR CHANGES WILL BE OVERWRITTEN
nameserver 127.0.1.1
```

#### 3. /etc/sysconfig/network

This configuration file specifies routing and host information for all network interfaces. It contains directives that are global specific. For example if NETWORKING=yes, then /etc/init.d/network activates network devices.

#### 4. /etc/nsswitch.conf

This file includes database search entries. The directive specifies which database is to be searched first.

The important Linux networking commands are

### 1. ifconfig

This command gives the configuration of all interfaces in the system. It can be run with an interface name to get the details of the interface.

```
ifconfig wlan0
```

```
Link encap:Ethernet HWaddr b8:03:05:ad:6b:23
inet addr:192.168.43.15 Bcast:192.168.43.255 Mask:255.255.255.0
inet6 addr: 2405:204:d206:d3b1:ba03:5ff:fead:6b23/64 Scope:Global
inet6 addr: fe80::ba03:5ff:fead:6b23/64 Scope:Link
inet6 addr: 2405:204:d206:d3b1:21ee:5665:de59:bd4e/64 Scope:Global
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:827087 errors:0 dropped:0 overruns:0 frame:0
TX packets:433391 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:1117797710 (1.1 GB) TX bytes:53252386 (53.2 MB)
```

This gives the IP address, subnet mask, and broadcast address of the wireless LAN adapter. Also tells that it can support multicasting.

If eth0 is given as the parameter, the command gives the details of the Ethernet adapter.

### 2. netstat

This command gives network status information.

```
Netstat -i
```

Iface	MTU	Met	RX-OK	RX-ERR	RX-DRP	RX-OVR	TX-OK	TX-ERR	TX-DRP	TX-OVR	Flg
eth0	1500	0	0	0	0	0	0	0	0	0	BMU
lo	65536	0	12166	0	0	0	12166	0	0	0	LRU
wlan0	1500	0	827946	0	0	0	434246	0	0	0	BMRU

As shown above, the command with -i flag provides information on the interfaces. lo stands for loopback interface.

### 3. ping

This is the most commonly used command for checking connectivity.

```
ping www.google.com
PING www.google.com (172.217.163.36) 56(84) bytes of data.
64 bytes from maa05s01-in-f4.1e100.net (172.217.163.36): icmp_seq=1 ttl=53 time=51.4 ms
64 bytes from maa05s01-in-f4.1e100.net (172.217.163.36): icmp_seq=2 ttl=53 time=50.3 ms
64 bytes from maa05s01-in-f4.1e100.net (172.217.163.36): icmp_seq=3 ttl=53 time=48.5 ms
64 bytes from maa05s01-in-f4.1e100.net (172.217.163.36): icmp_seq=4 ttl=53 time=59.8 ms
64 bytes from maa05s01-in-f4.1e100.net (172.217.163.36): icmp_seq=5 ttl=53 time=57.8 ms
64 bytes from maa05s01-in-f4.1e100.net (172.217.163.36): icmp_seq=6 ttl=53 time=59.2 ms
64 bytes from maa05s01-in-f4.1e100.net (172.217.163.36): icmp_seq=7 ttl=53 time=68.2 ms
64 bytes from maa05s01-in-f4.1e100.net (172.217.163.36): icmp_seq=8 ttl=53 time=58.8 ms
^C
--- www.google.com ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 7004ms
rtt min/avg/max/mdev = 48.533/56.804/68.266/6.030 ms
```

A healthy connection is determined by a steady stream of replies with consistent times. Packet loss is shown by discontinuity of sequence numbers. Large scale packet loss indicates problem along the path.