Term work

of

Computer Networks Lab (PCS – 604)

Submitted in partial fulfillment of the requirement for the VI semester

Bachelor of Technology

By

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Under the Guidance of

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CERTIFICATE

The term work of Computer Networks Lab , being submitted by Dev Joshi D/O Mr. Shankar Dutt Joshi University Roll Number 2261179 to Graphic Era Hill University, Bhimtal Campus for the award of bona fide work carried out by him. He has worked under my guidance and supervision and fulfilled the requirement for the submission of this work report.

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I want to extend thanks to our President **Prof. (Dr.) Kamal Ghanshala** for providing us all infrastructure and facilities to work in need without which this work would not be possible.

(Dev Joshi)

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1. **Familiarization of Network Environment, Understanding and using network utilities: ipconfig, netstat, ping, telnet, ftp, traceroute etc.**

1. **ipconfig (Internet Protocol Configuration)** ipconfig is a command-line utility available on Windows systems that displays and manages the IP address configuration of network interfaces. It is commonly used to view the current IP address, subnet mask, and default gateway assigned to the system. Advanced options allow users to release and renew IP addresses via DHCP.

Command Examples:

ipconfig # Shows basic network info
ipconfig /all # Shows detailed info (MAC address, DNS, DHCP status etc.)

2. **ifconfig (Interface Configuration)** ifconfig is the Linux/macOS equivalent of ipconfig. It is used to display, configure, and manage network interfaces. It can show IP addresses, MAC addresses, and allow enabling or disabling of interfaces.

Command Examples:

ifconfig # Show IP and MAC of interfaces
sudo ifconfig eth0 down # Disable a network
interface

3. **ping (Packet Internet Groper)** ping is a diagnostic tool used to test the reachability of a host on an IP network. It sends ICMP echo request packets to the target host and measures the time taken for the responses. It helps determine whether the destination device is online and how fast it responds.

Command Example:

ping google.com # Sends packets to Google's servers
ping 192.168.1.1 # Tests connectivity with local
router

4. tracert (Windows) / traceroute (Linux/macOS)

This utility traces the route that packets take to reach a destination host. It lists all the intermediate routers the packet passes through, along with the time taken at each hop. This is useful for identifying network bottlenecks or failures.

Command Example:

tracert google.com

5. **netstat (Network Statistics)** netstat is a command-line utility that displays active network connections, listening ports, and network protocol statistics. It helps users monitor open connections, detect suspicious activity, and troubleshoot network issues.

Command Examples:

netstat # Shows active connections
netstat -a # Shows all active ports and listening ports

6. **telnet (Teletype Network Protocol)** telnet is a network protocol and command-line tool used to establish a text-based communication session with a remote host using the TCP/IP protocol. It is often used to test connectivity to a specific port (like 80 for HTTP or 25 for SMTP), though it is now mostly replaced by more secure alternatives like SSH.

Command Example:

telnet google.com 80 # Test connection to port 80 (HTTP)

7. ftp (File Transfer Protocol)

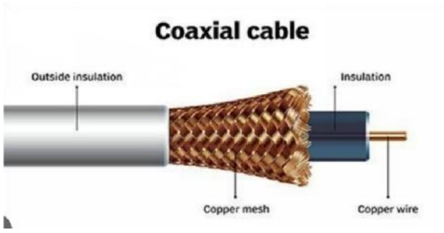
ftp is a standard network protocol used to transfer files between a client and a server over a TCP-based network. The ftp command-line tool allows users to upload and download files, authenticate with remote servers, and navigate remote directories.

Command Example:

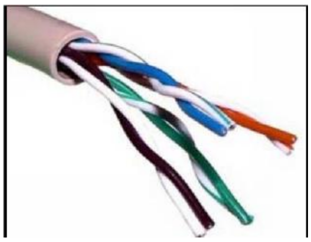
ftp ftp.example.com

2. Familiarization with Transmission media and tools: Co-axial cable, UTP cable, Crimping tool, Connectors etc. Preparing the UTP cable for cross and direct connection using crimping tool.

1. Coaxial Cable (Co-axial Cable)
A coaxial cable is a type of electrical cable with an inner conductor surrounded by a concentric conducting shield, separated by an insulating layer. It is commonly used for cable television, internet connections, and long-distance communication due to its excellent shielding from electromagnetic interference (EMI).
Use Case: Broadband internet, CCTV, cable TV
Connector Type: BNC, F-type

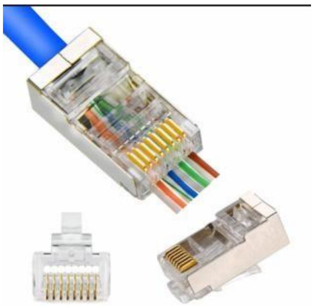


2. UTP Cable (Unshielded Twisted Pair)
A UTP cable consists of pairs of insulated copper wires twisted together. It lacks shielding, making it cheaper and more flexible, but more vulnerable to EMI. It is widely used in Ethernet networks and telephone systems. Types: Cat5, Cat5e, Cat6
Max Range (Ethernet): ~100 meters



3. Crimping Tool
A crimping tool is a hand tool used to attach connectors (such as RJ-45) to the ends of UTP cables. It ensures a secure and reliable electrical connection by pressing the connector's pins into the cable wires.
Function: Terminating cables with RJ-45 connectors

4. Connectors (RJ-45)
RJ-45 connectors are modular plugs used to connect UTP cables to networking devices. They have 8 pins that correspond to the 8 wires in a UTP cable. These connectors are crucial in forming both straight-through and crossover cables.
Pin Count: 8P8C (8 Positions, 8 Contacts)
Use: Ethernet, LAN connections



Preparing UTP Cable for Cross and Direct Connection

Straight-through Cable (Direct Connection) Used to connect different types of devices (e.g., PC → Switch, PC → Router).
Wiring Standard:

- Both ends use same color coding (usually T568B)

T568B Wiring Order:
1. Orange-White
2. Orange
3. Green-White
4. Blue
5. Blue-White
6. Green
7. Brown-White
8. Brown

Crossover Cable (Cross Connection)
Used to connect similar devices (e.g., PC ↔ PC, Switch ↔ Switch).
Wiring Standard:

- One end is T568A, the other is T568B

T568A End:		T568B End:
1. Green-White	↔	Orange-White
2. Green	↔	Orange
3. Orange-White	↔	Green-White
4. Blue	↔	Blue
5. Blue-White	↔	Blue-White
6. Orange	↔	Green
7. Brown-White	↔	Brown-White
8. Brown	↔	Brown

Steps to Crimp a UTP Cable
1. Strip ~1 inch of the cable jacket using the crimping tool.
2. Untwist and align the wires as per the color code (T568A or B).
3. Trim wires evenly using the cutter.
4. Insert wires into the RJ-45 connector — ensure all reach the end.
5. Insert connector into the crimping slot and press hard.
6. Repeat on the other side as per the required cable type (cross/direct).

3. Installation and introduction of simulation tool. (Packet Tracer)

Introduction to Cisco Packet Tracer

Cisco Packet Tracer is a powerful network simulation and visualization tool developed by Cisco Systems. It is widely used in academic environments, particularly in Cisco Networking Academy programs, to provide students and networking professionals with a realistic and interactive platform for designing, configuring, and troubleshooting network topologies without requiring physical networking equipment. Packet Tracer supports a wide range of networking components, including routers, switches, wireless devices, PCs, and IoT devices. It provides both real-time and simulation modes, enabling users to observe packet flow and protocol behavior in detail.

Key Features of Packet Tracer

Feature	Description
Device Simulation	Simulates routers, switches, PCs, laptops, servers, firewalls, and IoT devices.
Real-time Mode	Emulates live network behavior for active packet flow and protocol execution.
Simulation Mode	Allows users to step through packet transmission for deeper analysis.
CLI Support	Provides a command-line interface similar to Cisco IOS for configuring devices.
Logical and Physical Views	Users can design topologies logically and visualize physical arrangements.
Multi-User Collaboration	Supports network collaboration in a classroom or remote learning environment.
IoT and Programming	Includes basic IoT device simulation and allows programming using JavaScript or Python.

Importance of Packet Tracer

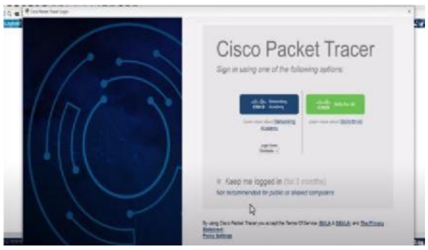
- Enables hands-on learning of networking concepts.
- Eliminates the cost of purchasing physical routers and switches.
- Ideal for practicing CCNA, CCNP, and other networking certifications.
- Facilitates experimentation and troubleshooting in a risk-free environment. Supports remote learning, making it accessible to students globally.

Installation Steps for Cisco Packet Tracer

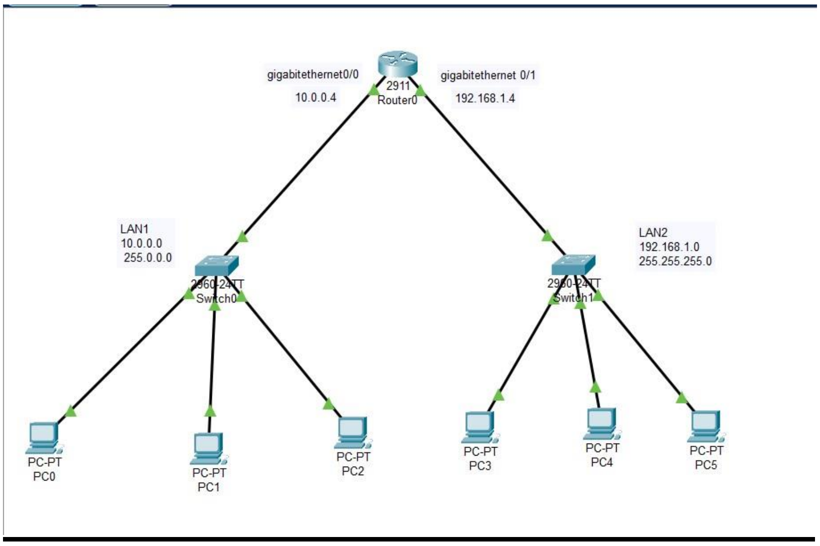
Step-by-Step Installation Process (Windows)

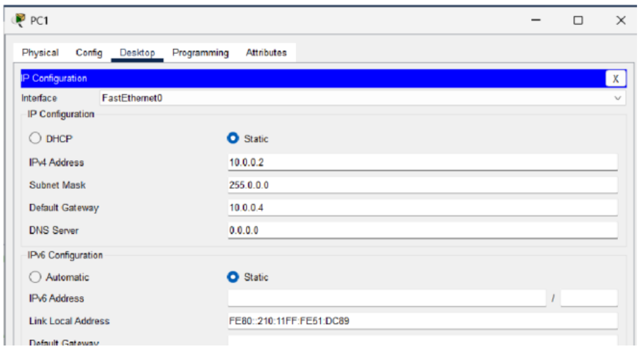
1. Register on Cisco Networking Academy: ○ Visit: https://www.netacad.com ○ Create a free account and enroll in the *Introduction to Packet Tracer* course.
2. Download the Software: ○ After enrollment, navigate to the Packet Tracer download section.
    - ○ Choose the appropriate version for your operating system.
3. Install Packet Tracer: ○ Run the downloaded installer file.
    - ○ Accept the license agreement. ○ Choose the installation directory (default is recommended).
    - ○ Complete the installation process.
4. Launch and Sign In:

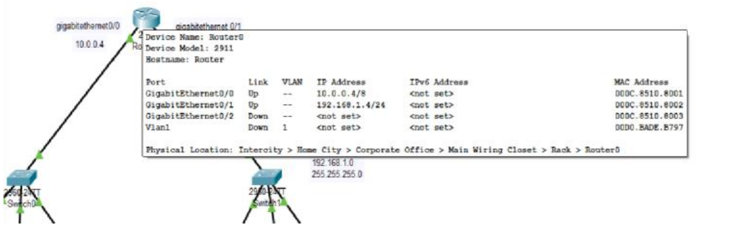
- Open Packet Tracer.
- Log in using your Cisco Networking Academy credentials.



4. To configure a basic network topology consisting of routers, switches, and end devices such as PCs or laptops. Configure IP addresses and establish connectivity between devices. (Using packet Tracer)







Step 1: Place Devices

- 1 Router (e.g. 2811)
- 2 Switches (e.g. 2960)
- 4 PCs (2 per network, PC0 & PC1 on SW1, PC2 & PC3 on SW2)

Step 2: Connect with Cables
Use copper straight-through cables:

- PC0 → SW1 (any FastEthernet port)
- PC1 → SW1
- PC2 → SW2
- PC3 → SW2
- SW1 → Router (Router's FastEthernet0/0)
- SW2 → Router (Router's FastEthernet0/1)

Use Router interfaces that are FastEthernet (Fa0/0, Fa0/1) or GigabitEthernet depending on router model.

Step 3: Assign IP Addresses
Network 1:

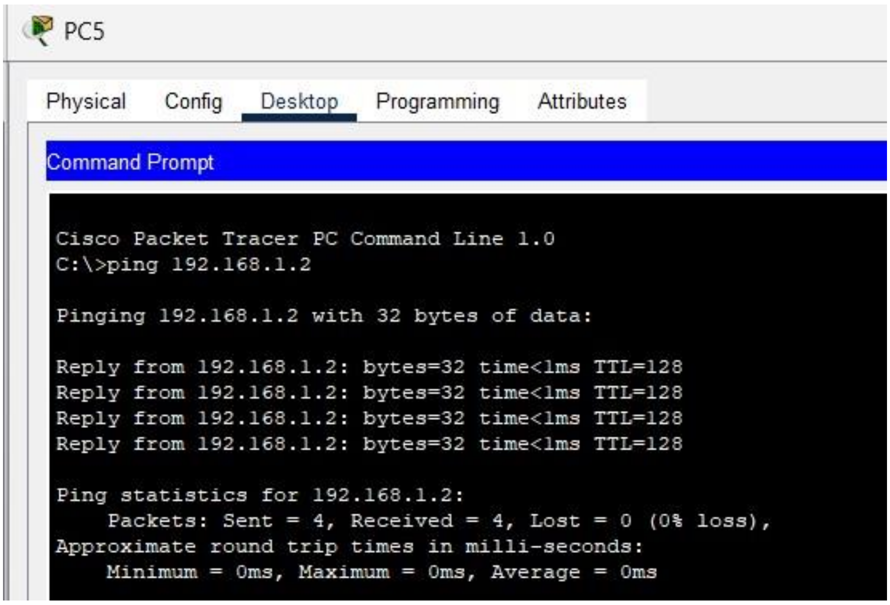
- Router Fa0/0 → 192.168.1.1 /24
- PC0 → 192.168.1.10 /24, Gateway: 192.168.1.1
- PC1 → 192.168.1.11 /24, Gateway: 192.168.1.1 Network 2:

- Router Fa0/1 → 192.168.2.1 /24
- PC2 → 192.168.2.10 /24, Gateway: 192.168.2.1
- PC3 → 192.168.2.11 /24, Gateway: 192.168.2.1

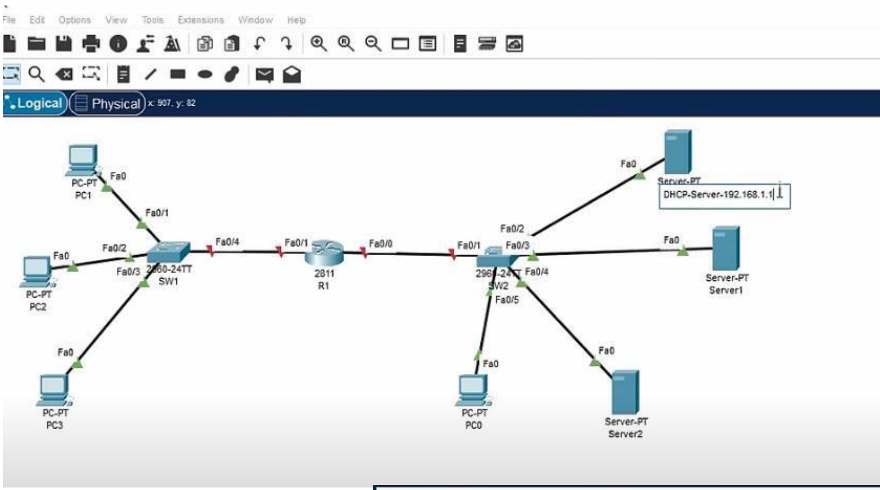
Step 4: Configure Router Interfaces
Click the Router → CLI tab → type the
following: enable configure terminal interface
FastEthernet0/0 ip address 192.168.1.1
255.255.255.0
no shutdown interface
FastEthernet0/1 ip address
192.168.2.1 255.255.255.0
no shutdown
exit

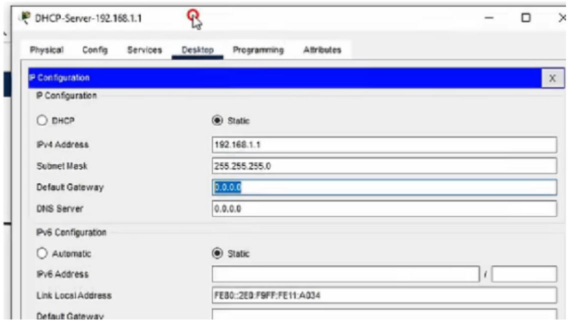
Step 5: Configure PCs
Click on each PC → Desktop tab → IP Configuration:
PC0:
IP: 192.168.1.10
Subnet: 255.255.255.0
Gateway: 192.168.1.1
Repeat similar for all PCs using IPs we assigned.

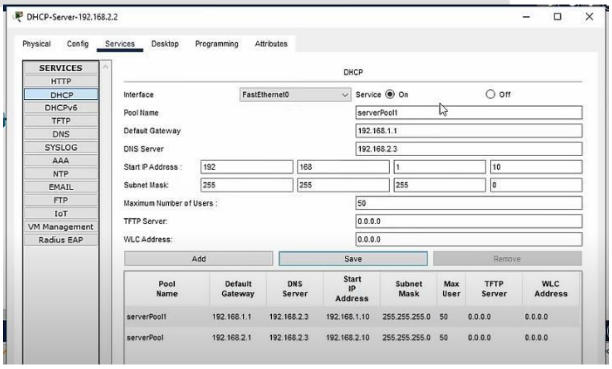
Step 6: Test Connectivity
 Open PC0 → Desktop → Command Prompt → type:
ping 192.168.1.11 # PC1 (same LAN) ping
192.168.2.10 # PC2 (other LAN via router)



5. To configure a DHCP server on a router or a dedicated DHCP server device. Assign IP addresses dynamically to devices on the network and verify successful address assignment. **(Using packet Tracer)**







Step 1: Connect devices

- Use **straight-through cables**:
  - PC0, PC1, PC2 → Switch o

Switch → Router's FastEthernet0/0 **Step 2:**

Decide IP Pool

Let's say we want to assign:

- **Network**: 192.168.10.0/24

- **Gateway (router)**: 192.168.10.1 - **IP Pool Range**: 192.168.10.100 to 192.168.10.200 **Step 3: Configure Router as DHCP Server**

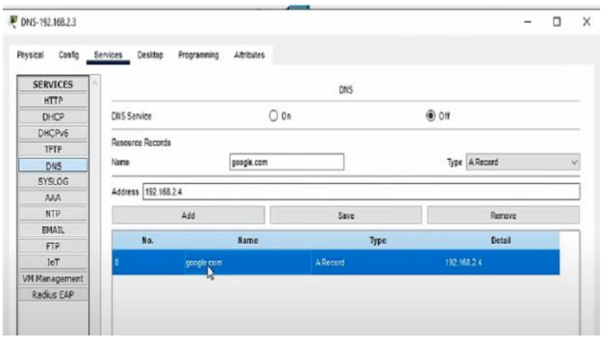
Click Router → CLI tab : `enable`

```
configure terminal

! Set up the DHCP pool ip
dhcp pool AyushNet
 network 192.168.10.0 255.255.255.0
default-router 192.168.10.1  dns-
server 8.8.8.8
```

```
! Exclude some addresses (like gateway, servers, etc.) ip
dhcp excluded-address 192.168.10.1 192.168.10.99

! Assign IP to router interface (gateway) interface
FastEthernet0/0
 ip address 192.168.10.1 255.255.255.0
no shutdown exit
```



Step 4: Configure PCs for DHCP

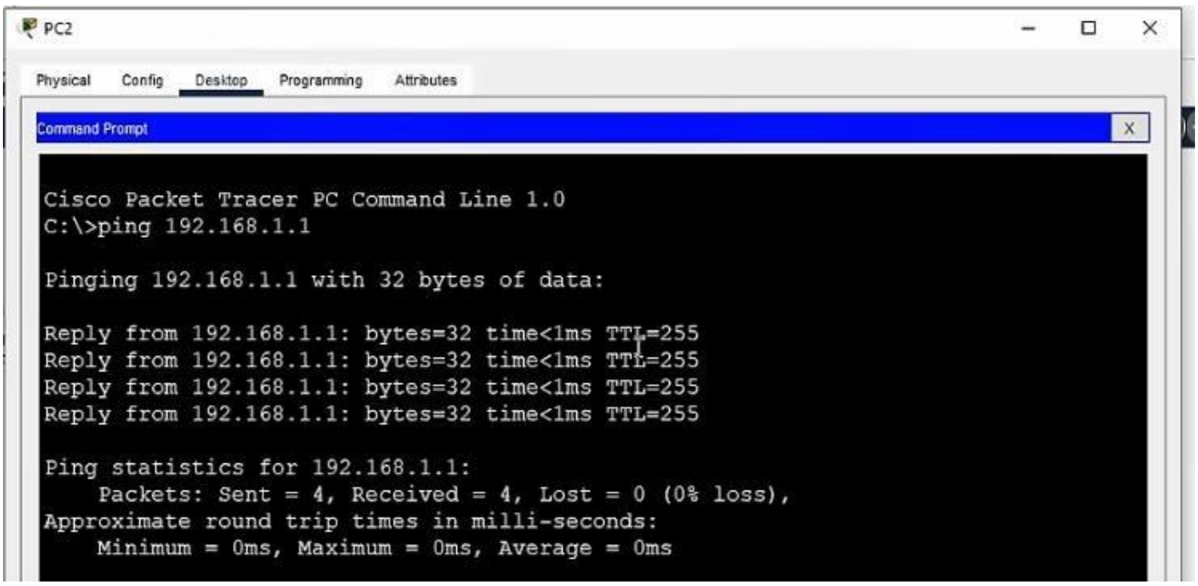
Click PC0 → Desktop → **IP Configuration** → choose

DHCP Do the same for PC1, PC2, etc.

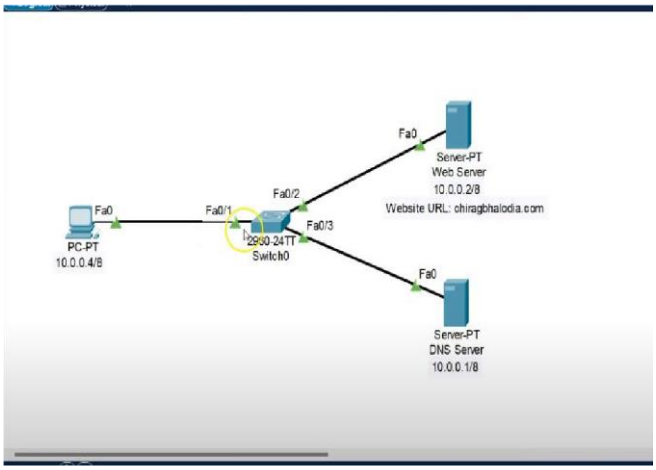
Step 5: Verify

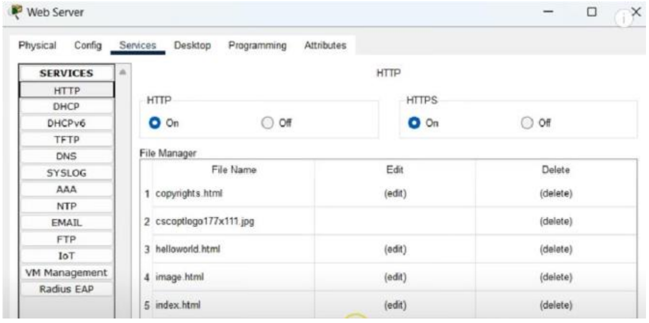
On each PC, after clicking DHCP:

- It should auto-fill with an IP like 192.168.10.100+
- Subnet Mask: 255.255.255.0
- Gateway: 192.168.10.1 Now test it: ping 192.168.10.1 # router ping 192.168.10.101 # other PC



6. To configure a local DNS server to resolve domain names within a network. (Using packet Tracer)





Step 1: Connections
Use **straight-through cables**:

- PC0, PC1 → Switch
- DNS Server → Switch
- Switch → Router (Fa0/0)

Step 2: Assign Static IPs
Use the **192.168.10.0/24** network:

Device	**IP Address**	**Notes**
Router (Fa0/0)	192.168.10.1	Default Gateway
DNS Server	192.168.10.2	DNS service runs here
PC0	DHCP or Static	Gets DNS from config
PC1	Same as PC0	

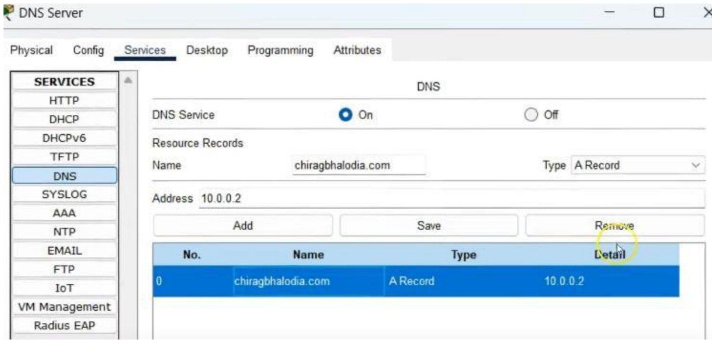
Step 3: Configure the DNS Server
Click the Server → **Config tab** → Set static IP (as above)
Then:

- Go to **Services tab** → Select **DNS**
- Turn DNS service **ON**
- Add DNS records (name-to-IP mappings):

Name **Address**

ayushgod.local 192.168.10.100

packettracer.local 192.168.10.101



Step 4: Configure PC to Use the DNS Server

Click PC0 → Desktop → IP Configuration:

IP Address: 192.168.10.10

Subnet Mask: 255.255.255.0

Gateway: 192.168.10.1

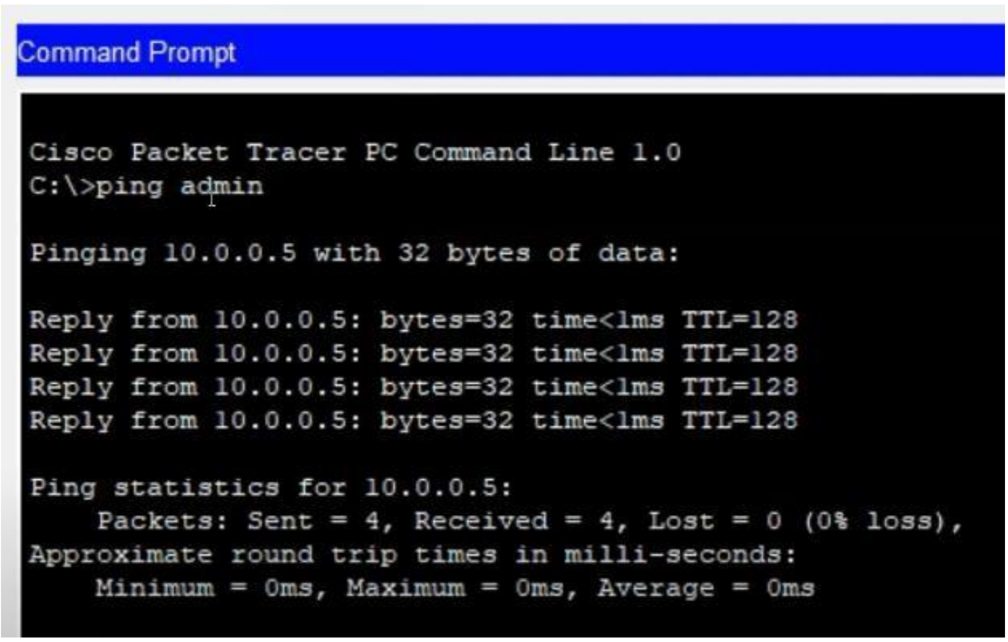
DNS Server: 192.168.10.2

(Repeat for PC1 or use DHCP)

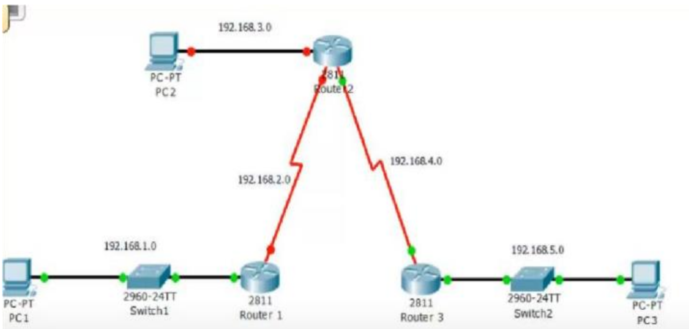
Step 5: Test DNS Resolution

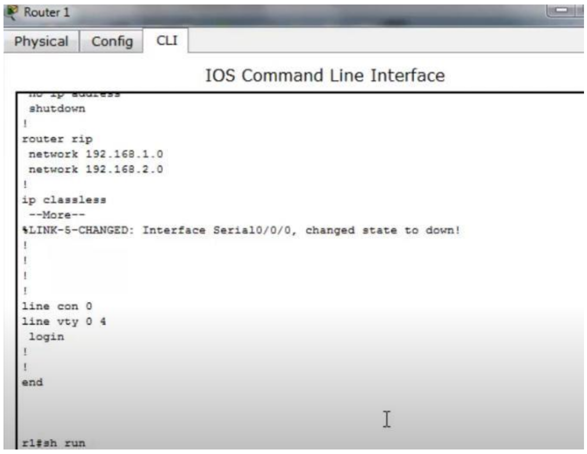
Open PC0 → Desktop → Command Prompt:

ping ayushgod.local



7. Network Troubleshooting: Simulate network issues such as connectivity problems, incorrect configurations, or routing failures. Use Packet Tracer's simulation mode to diagnose and troubleshoot the network.





Step 1: Inject Some Mistakes
Let's deliberately break some stuff:

Issue Type	**Problem Introduced**
IP Misconfig	Set wrong IP on PC1 (192.168.30.10)
Wrong Gateway	Set PC0's gateway to 192.168.10.254
Cable Cut	Disconnect Fa0/1 to LAN2
Interface Shutdown	shutdown Fa0/0 on router
Routing Failure	No routes configured on multi-router setup

Step 2: Simulation Mode to Sniff Packets
How to Use:

1. Click Simulation Mode (bottom right in Packet Tracer).
2. Click Add Simple PDU (lightning bolt with a +).
3. Click PC0 → PC1.
4. See the packet move hop-by-hop.
5. When it fails — click the red X → analyze the problem in the Event List.

Common Diagnoses & Fixes:
Issue #1: PC IP Misconfig
Symptom: PC1 not pingable, can't reach network.
Fix:

- Click PC1 → Desktop → IP Config → Fix IP:

IP Address: 192.168.20.10
Subnet: 255.255.255.0
Gateway: 192.168.20.1

Issue #2: Wrong Gateway on PC0
Symptom: PC0 can't reach PC1 even though IP is correct.

Fix:

- Set correct gateway:

Gateway: 192.168.10.1

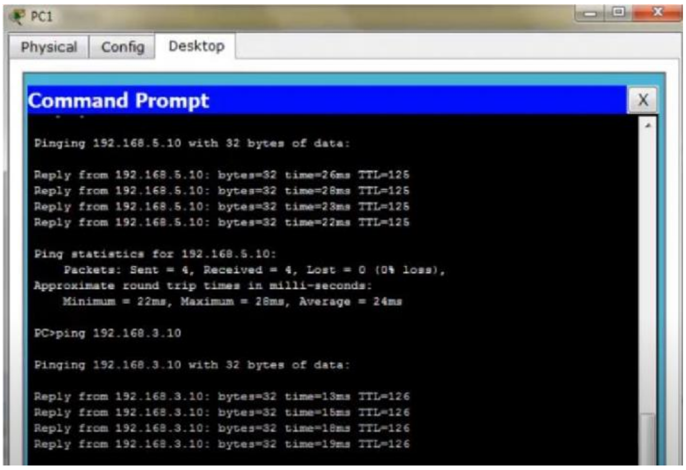
Issue #3: Cable unplugged / Interface Down
Symptom: Link light is red or off, packet dies at router.
Fix:

- Check physical connections.
- On Router CLI: enable configure terminal interface FastEthernet0/1 no shutdown

Issue #4: No Routing Between
Networks If you're using 2 routers, you
need routing. Static Routing Fix:
RouterA(config)# ip route 192.168.20.0 255.255.255.0 [next-hop]
RouterB(config)# ip route 192.168.10.0 255.255.255.0 [next-hop]

Step 3: Verify Fix
After each fix:

- Go back to Simulation Mode
- Re-send PDU
- Make sure the packet reaches the destination
- Green ✓ means success



8. NAT (Network Address Translation): Set up NAT on a router to translate private IP addresses to public IP addresses for outbound internet connectivity. Test the translation and examine how NAT helps conserve IPv4 address space. (Using packet Tracer)

Objective:

- Set up NAT on a router to translate private IPs to public IPs.
- Test the translation using ping.
- Understand how NAT helps conserve IPv4 addresses.

Step 1: Create Topology

1. **Place devices**: 2 PCs, 1 Router (NAT), 1 Server (simulating public server), 1 Cloud (optional).
2. **Connect using copper cables**:
   - PC0 & PC1 → Router (FastEthernet0/0)
   - Router (Serial or FastEthernet0/1) → Server0 or ISP Router

Step 2: Assign IP Addresses

Step 3: Configure IPs

PCs:

- On each PC > Desktop > IP Configuration

Router

Enter CLI and run:

```
enable
configure terminal

interface FastEthernet0/0
ip address 192.168.1.1 255.255.255.0
ip nat inside
no shutdown
exit

interface FastEthernet0/1
ip address 203.0.113.2 255.255.255.0
ip nat outside
no shutdown
exit
```

Step 4: Configure NAT

```
access-list 1 permit 192.168.1.0 0.0.0.255
```

ip nat inside source list 1 interface FastEthernet0/1 overload

Step 5: Configure Routing

ip route 0.0.0.0 0.0.0.0 203.0.113.1 ! Assuming 203.0.113.1 is the ISP or next hop

Step 6: Test NAT

1. From PC0/PC1, go to **Command Prompt** > ping 203.0.113.3 (Server).
2. You should receive replies.

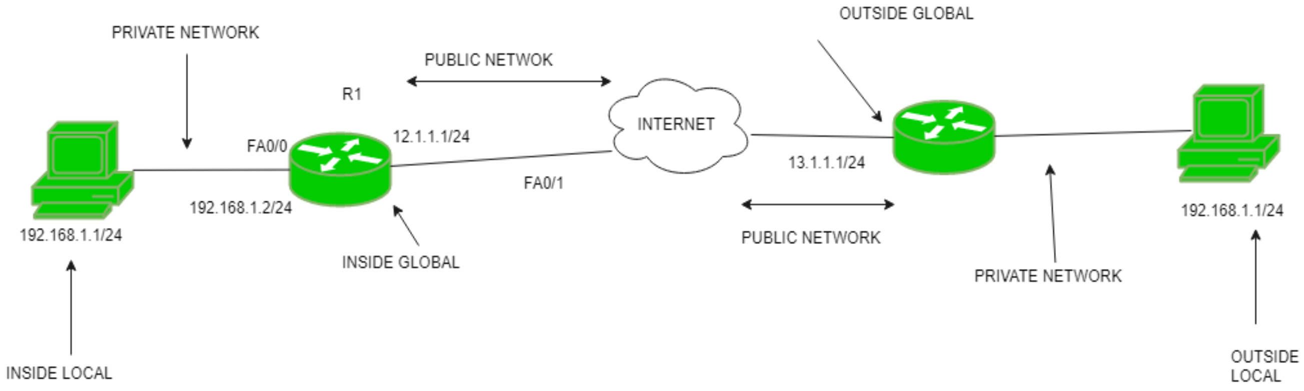
Step 7: View NAT Translations

On Router CLI:

show ip nat translations

You'll see mappings like:

Inside global: 203.0.113.2 Inside local: 192.168.1.10



9.

To monitor network traffic using **Wire Shark**

Objective:
To **capture, monitor, and analyze network traffic** using **Wireshark**.

Step 1: Install Wireshark

- Download from https://www.wireshark.org

Step 2: Open Wireshark

- Launch the Wireshark application.

Step 3: Select a Network Interface

- On the home screen, you will see a list of available network interfaces.
- Select the interface you want to monitor (e.g., **Wi-Fi**, **Ethernet**).
    - You can identify active interfaces by seeing live packet activity (spikes).

Step 4: Start Capturing Packets

- Click on the interface name or press the **shark fin icon** (top left) to start capturing.

Step 5: Generate Network Traffic

- Open a browser and visit websites.
- Use apps that access the internet (e.g., YouTube, Email clients).
- This will generate live packets visible in Wireshark.

Step 6: Stop Capturing

- Click the **red square button** (stop icon) to stop the capture.

Step 7: Analyze Captured Packets

- You'll see packet details like:
    - **Time**
    - **Source & Destination IP**
    - **Protocol** (TCP, UDP, HTTP, etc.)
    - **Info**
- Click on a packet to see detailed breakdown in the **middle and bottom panes**.

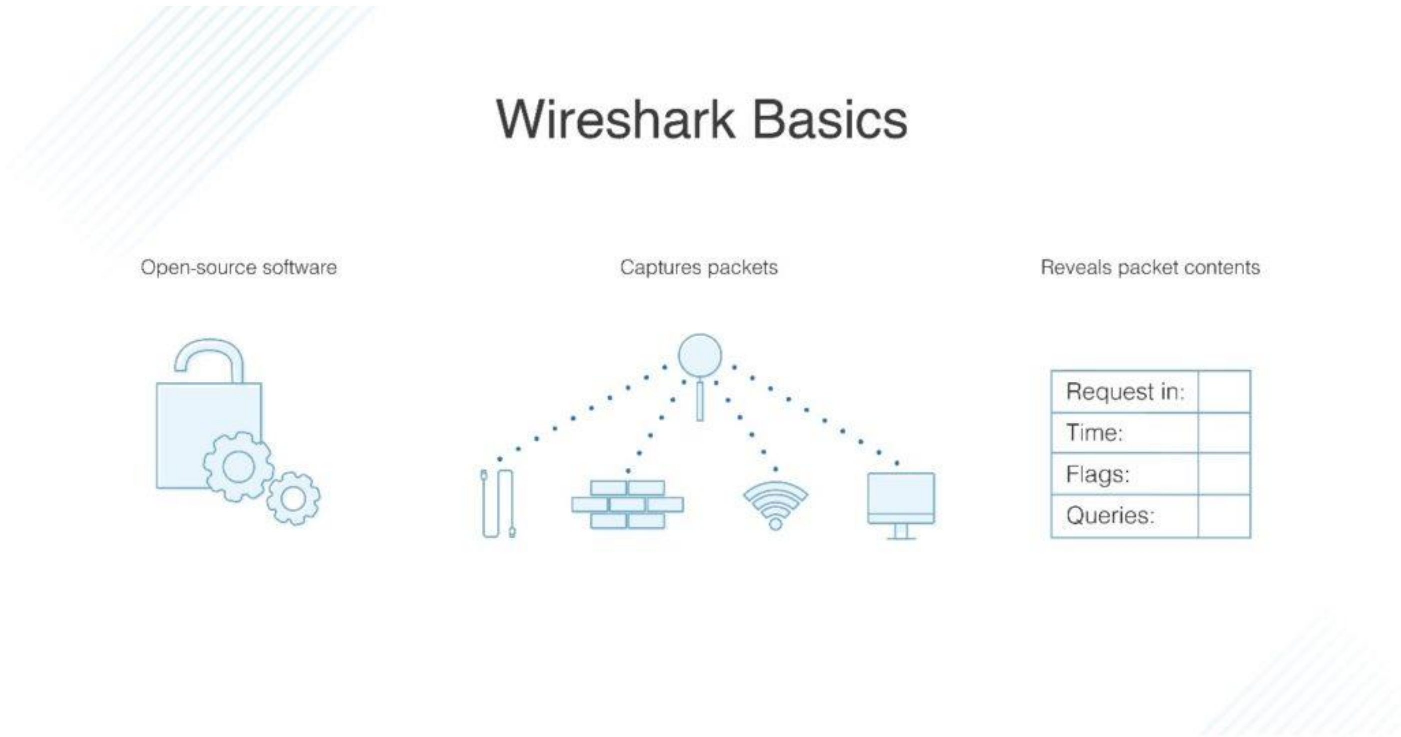
Step 8: Apply Display Filters (Optional)

Use filters to focus on specific traffic, e.g.:

- http → show only HTTP packets
- ip.addr == 192.168.1.1 → filter traffic from/to a specific IP
- tcp.port == 80 → filter traffic on port 80 (HTTP)

Step 9: Save the Capture (Optional)

- File > Save As > choose .pcapng format
- Useful for analysis later or sharing



10.

To analyze complete TCP/IP protocol suite layer's headers using Wire Shark

Objective:

To **capture a packet** and examine the headers for each layer of the **TCP/IP model**:
Application Layer (HTTP, DNS, etc.)
Transport Layer (TCP, UDP)
Internet Layer (IP header)
Link Layer (Ethernet header)

Step 1: Open Wireshark
Launch Wireshark on your computer.

Step 2: Select a Network Interface
Choose your **active network interface** (Wi-Fi or Ethernet) based on traffic activity.
Click to start capturing.

Step 3: Generate TCP/IP Traffic
Open a web browser and visit any website (e.g., www.google.com).
This generates **HTTP over TCP/IP** traffic.

Step 4: Stop the Capture
After a few seconds, click the **red stop button** to halt the packet capture.

Step 5: Apply a Display Filter (Optional)
To easily find relevant packets:
`http`

Step 6: Select a TCP Packet
Look at the "Protocol" column, and click on a packet with:
Protocol: HTTP, TCP, or DNS (for better analysis)

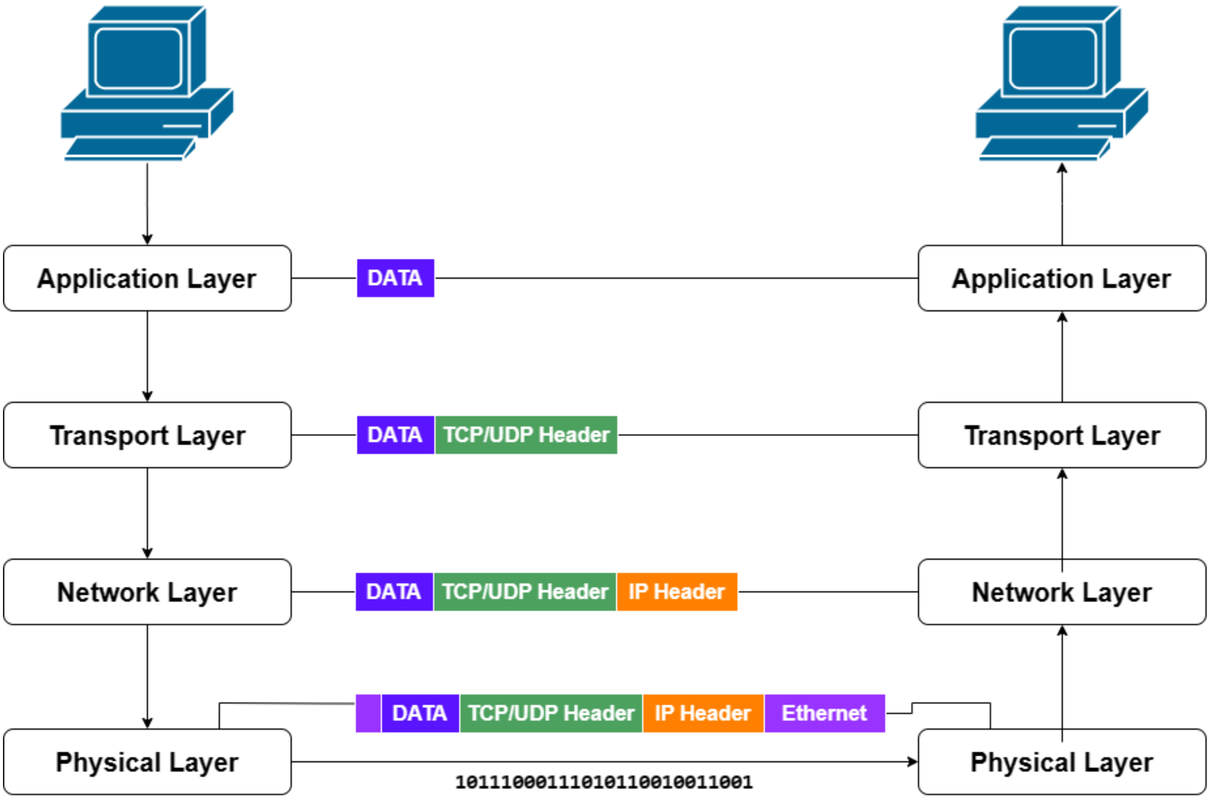
Step 7: Expand Packet Details by Layer
Once you select a packet, expand the following in the **middle pane**:

Layer 1: Data Link Layer (Ethernet)
Header: **Ethernet II**
Fields include:
Destination MAC address
Source MAC address
Type (e.g., 0x0800 for IP)

Layer 2: Network Layer (IP)
Header: **Internet Protocol Version 4 (IPv4)**
Fields include:
Source and Destination IP addresses
TTL

Header length
Protocol (e.g., TCP - protocol number 6)
Layer 3: Transport Layer (TCP/UDP)
Header: **Transmission Control Protocol (TCP)** or **User Datagram Protocol (UDP)**
Fields include:
Source and Destination ports
Sequence number
Acknowledgment number
Flags (SYN, ACK, etc.)
Window size
Layer 4: Application Layer
Header: Depends on protocol (HTTP, DNS, etc.)
For HTTP: Method (GET/POST), Host, User-Agent, etc.
For DNS: Query Name, Type, Class

Step 8: Analyze Each Field
You can right-click any section and choose **“Expand All”** or **“Copy as Printable Text”**.
You may also **"Follow TCP Stream"** for full application-layer conversations.



11. **TCP Client-Server Communication:**

Implement a TCP client program that sends a message to a TCP server program.

Implement the corresponding TCP server program that receives the message and displays it.

Test the communication between the client and server by exchanging messages
(Using 'C' Language)

Tools Required:
A C compiler (e.g., GCC)
Run on Linux/Unix or Windows (using MinGW or Code::Blocks)

1. TCP Server Code (C Language)

```
// File: tcp_server.c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>        // for close()
#include <netinet/in.h>    // for sockaddr_in

#define PORT 8080
#define BUFFER_SIZE 1024

int main() {
    int server_fd, new_socket;
    char buffer[BUFFER_SIZE] = {0};
    struct sockaddr_in address;
    int addrlen = sizeof(address);

    // 1. Create socket
    server_fd = socket(AF_INET, SOCK_STREAM, 0);
    if (server_fd == 0) {
        perror("Socket failed");
        exit(EXIT_FAILURE);
    }

    // 2. Bind socket to IP/Port
    address.sin_family = AF_INET;
    address.sin_addr.s_addr = INADDR_ANY;  // Accept connections from any IP
    address.sin_port = htons(PORT);
```

```c
    if (bind(server_fd, (struct sockaddr*)&address, sizeof(address)) < 0) {
        perror("Bind failed");
        exit(EXIT_FAILURE);
    }

    // 3. Listen
    if (listen(server_fd, 3) < 0) {
        perror("Listen failed");
        exit(EXIT_FAILURE);
    }

    printf("Server is listening on port %d...\n", PORT);

    // 4. Accept connection
    new_socket = accept(server_fd, (struct sockaddr*)&address, (socklen_t*)&addrlen);
    if (new_socket < 0) {
        perror("Accept failed");
        exit(EXIT_FAILURE);
    }

    // 5. Read message from client
    read(new_socket, buffer, BUFFER_SIZE);
    printf("Message from client: %s\n", buffer);

    // Optional: Send a reply
    char *reply = "Hello from server!";
    send(new_socket, reply, strlen(reply), 0);

    // 6. Close sockets
    close(new_socket);
    close(server_fd);

    return 0;
}
```

2. TCP Client Code (C Language)

```c
// File: tcp_client.c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>        // for close()
#include <arpa/inet.h>     // for sockaddr_in, inet_addr
#define PORT 8080
```

```c
#define BUFFER_SIZE 1024
int main() {
    int sock = 0;
    struct sockaddr_in serv_addr;
    char *message = "Hello from client!";
    char buffer[BUFFER_SIZE] = {0};
    // 1. Create socket
    sock = socket(AF_INET, SOCK_STREAM, 0);
    if (sock < 0) {
        printf("\n Socket creation error \n");
        return -1;
    }
    // 2. Set server address
    serv_addr.sin_family = AF_INET;
    serv_addr.sin_port = htons(PORT);
    // Convert IPv4 addresses from text to binary
    if (inet_pton(AF_INET, "127.0.0.1", &serv_addr.sin_addr) <= 0) {
        printf("\nInvalid address/Address not supported \n");
        return -1;
    }
    // 3. Connect to server
    if (connect(sock, (struct sockaddr*)&serv_addr, sizeof(serv_addr)) < 0) {
        printf("\nConnection Failed \n");
        return -1;
    }
    // 4. Send message to server
    send(sock, message, strlen(message), 0);
    printf("Message sent to server: %s\n", message);
    // 5. Read server reply
    read(sock, buffer, BUFFER_SIZE);
    printf("Message from server: %s\n", buffer);
    // 6. Close socket
    close(sock);
    return 0;
}
```

How to Compile & Run

On Linux Terminal:

```
gcc tcp_server.c -o server
gcc tcp_client.c -o client
```

Run in two separate terminals:

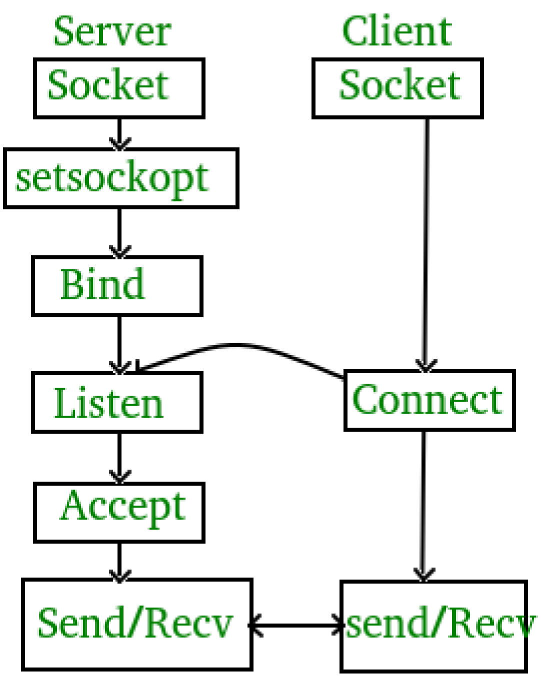
Terminal 1 (Start Server):

```
./server
```

Terminal 2 (Start Client):

./client

Output Example
Server:
Server is listening on port 8080...
Message from client: Hello from client!
Client:
Message sent to server: Hello from client!
Message from server: Hello from server!



12. UDP Client-Server Communication:

Implement a UDP client program that sends a message to a UDP server program.

Implement the corresponding UDP server program that receives the message and displays it
(Using 'C' Language)

Objective:

Implement a **UDP client** that sends a message.
Implement a **UDP server** that receives and displays it.
Use **sockets** and **Datagram communication**.

Step 1: UDP Server Code (udp_server.c)

```
// File: udp_server.c
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <string.h>
#include <arpa/inet.h>

#define PORT 8080
#define BUFFER_SIZE 1024

int main() {
    int sockfd;
    char buffer[BUFFER_SIZE];
    struct sockaddr_in servaddr, cliaddr;

    // 1. Create socket
    sockfd = socket(AF_INET, SOCK_DGRAM, 0);
    if (sockfd < 0) {
        perror("Socket creation failed");
        exit(EXIT_FAILURE);
    }

    // 2. Define server address
    memset(&servaddr, 0, sizeof(servaddr));
    memset(&cliaddr, 0, sizeof(cliaddr));

    servaddr.sin_family = AF_INET;          // IPv4
    servaddr.sin_addr.s_addr = INADDR_ANY;  // Any IP
    servaddr.sin_port = htons(PORT);        // Port
```

```
    // 3. Bind the socket with the server address
    if (bind(sockfd, (const struct sockaddr *)&servaddr, sizeof(servaddr)) < 0) {
        perror("Bind failed");
        close(sockfd);
        exit(EXIT_FAILURE);
    }

    printf("UDP Server is running on port %d...\n", PORT);

    // 4. Receive message
    int len, n;
    len = sizeof(cliaddr);
    n = recvfrom(sockfd, buffer, BUFFER_SIZE, 0, (struct sockaddr *) &cliaddr, &len);
    buffer[n] = '\0';

    // 5. Display message
    printf("Message from client: %s\n", buffer);

    // Optional: Send reply
    char *reply = "Message received!";
    sendto(sockfd, reply, strlen(reply), 0, (struct sockaddr *) &cliaddr, len);

    // 6. Close socket
    close(sockfd);

    return 0;
}
```

Step 2: UDP Client Code (udp_client.c)

```
// File: udp_client.c
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <string.h>
#include <arpa/inet.h>

#define PORT 8080
#define BUFFER_SIZE 1024

int main() {
    int sockfd;
    char buffer[BUFFER_SIZE];
    char *message = "Hello from client!";
    struct sockaddr_in servaddr;
```

```
    // 1. Create socket
    sockfd = socket(AF_INET, SOCK_DGRAM, 0);
    if (sockfd < 0) {
        perror("Socket creation failed");
        exit(EXIT_FAILURE);
    }

    // 2. Define server address
    memset(&servaddr, 0, sizeof(servaddr));
    servaddr.sin_family = AF_INET;
    servaddr.sin_port = htons(PORT);
    servaddr.sin_addr.s_addr = inet_addr("127.0.0.1");

    // 3. Send message to server
    sendto(sockfd, message, strlen(message), 0, (const struct sockaddr *) &servaddr,
sizeof(servaddr));
    printf("Message sent to server: %s\n", message);

    // 4. Receive reply from server
    int len, n;
    len = sizeof(servaddr);
    n = recvfrom(sockfd, buffer, BUFFER_SIZE, 0, (struct sockaddr *) &servaddr,
&len);
    buffer[n] = '\0';

    printf("Message from server: %s\n", buffer);

    // 5. Close socket
    close(sockfd);

    return 0;
}
```

Step 3: Compile and Run

```
gcc udp_server.c -o udp_server
gcc udp_client.c -o udp_client
```

Run in two terminal windows:

Terminal 1:

```
./udp_server
```

Terminal 2:

```
./udp_client
```

Output Example

Server Output:
UDP Server is running on port 8080...
Message from client: Hello from client!
Client Output:
Message sent to server: Hello from client!
Message from server: Message received!