LAB MANUAL
COMPUTER Networking AND SECURITY

Course Overview

This course introduces students to networking fundamentals through hands-on labs. Class 1–5 cover physical components and basic concepts without software, while class 6–20 use Cisco Packet Tracer for virtual simulations. Each 3-hour session builds toward a capstone project where students design and present a small office network.

[Updated course materials](#)

Day	Topic	Class Goal	Key Activities
1	Introduction to Networking Basics	Understand networks and components	Label devices, draw network diagram
2	Network Cables and Connectors	Make and test Ethernet cables	Crimp T568-B cable, test connectivity
3	IP Addressing Basics	Learn IP addresses and subnetting	Classify IPs, calculate subnets
4	Network Topologies	Understand topology types	Compare topologies, design star topology
5	Basic Network Troubleshooting	Troubleshoot connectivity issues	Use ping, fix cable/IP issues
6	Introduction to Packet Tracer	Navigate Cisco Packet Tracer	Build simple network, test ping
7	Configuring a LAN	Build a LAN in Packet Tracer	Configure IPs, test connectivity
8	Introduction to Routers	Connect LANs with a router	Configure router interfaces, test ping
9	Subnetting Practice	Design subnetted network	Create subnets, assign IPs
10	Introduction to DHCP	Set up DHCP server	Configure DHCP, test dynamic IPs

11	VLAN Basics	Configure VLANs	Create VLANs, test segmentation
12	Static Routing	Configure static routes	Set up routes, test inter-network ping
13	Wireless Networking	Set up secure wireless network	Configure access point, test WPA2
14	Network Security Basics	Implement firewall rules (ACLs)	Configure ACLs, test traffic blocking
15	Troubleshooting in Packet Tracer	Fix network issues	Diagnose errors, document fixes
16	Network Protocols	Explore HTTP protocol	Configure HTTP server, access webpage
17	DNS Configuration	Set up DNS server	Configure DNS, test name resolution
18	NAT Configuration	Configure NAT	Set up NAT, test private-to-public
19	Capstone Project Setup	Plan office network	Sketch design, start Packet Tracer setup
20	Capstone Project Completion	Finalize and present network	Complete network, present to class

Topic 1: Introduction to Networking Basics

Goal: Understand what a network is and identify its key components.

What You'll Learn:

- **Network**: A group of connected computers that share information.
- **LAN (Local Area Network)**: A network in a small area, like a classroom.
- **WAN (Wide Area Network)**: A network covering a large area, like the internet.
- **Devices**: Routers (direct traffic), switches (connect devices), and network interface cards (NICs).

Lab Instructions:

1. **Listen to the Intro**: Your teacher will explain networking and show examples of devices (routers, switches, cables).
2. **Label Devices**: Get a handout with pictures of network devices. Write their names (e.g., router, switch) and what they do.
3. **Draw a Network**:
   - On paper, sketch two computers connected to a switch with Ethernet cables.
   - Label each part (computer, switch, cables).
   - Show your drawing to your teacher.
4. **Discuss**: Talk with your class about why networks matter (e.g., for internet, gaming).

Tips:

- Ask questions if terms like LAN or router are confusing.
- Keep your drawing simple but clear.

Topic 2: Understanding Network Cables and Connectors

Goal: Learn to make and test Ethernet cables.

What You'll Learn:

- **Ethernet Cable**: A cable that connects devices in a network.
- **Straight-Through Cable**: Connects different devices (e.g., computer to switch).
- **Crossover Cable**: Connects similar devices (e.g., computer to computer).
- **T568-B**: A standard for arranging wires in a cable.

Lab Instructions:

1. **Watch the Demo**: Your teacher will show how to crimp an Ethernet cable.
2. **Crimp a Cable**:
   ○ Get a Cat5e/Cat6 cable, RJ45 connector, and crimping tool.
   ○ Strip the cable end to expose the wires.
   ○ Arrange wires in T568-B order: Orange-White, Orange, Green-White, Blue, Blue-White, Green, Brown-White, Brown.
   ○ Insert wires into the RJ45 connector and crimp with the tool.
3. **Test the Cable**:
   ○ Plug your cable into a cable tester.
   ○ Check if all lights indicate a good connection.
   ○ If it fails, re-crimp or ask for help.
4. **Write Notes**: In your lab notebook, list the steps you took and any issues.

Safety:

- Be careful with the crimping tool—it's sharp!
- Don't touch exposed wires.

Tips:

- Double-check the wire order before crimping.
- Keep your workspace tidy.

Topic 3: IP Addressing Basics

Goal: Learn about IP addresses and how to divide networks with subnetting.

What You'll Learn:

- **IP Address**: A unique number for each device on a network (e.g., 192.168.1.1).
- **IPv4**: Common format with four numbers (e.g., 192.168.1.1).
- **IPv6**: Newer format with longer addresses (e.g., 2001:0db8::1).
- **Subnet Mask**: Divides a network into smaller parts (e.g., 255.255.255.0).

Lab Instructions:

1. **Learn IP Basics**: Your teacher will explain IP addresses and subnet masks.
2. **Classify IPs**:
   ○ Get a handout with IP addresses (e.g., 192.168.1.10, 10.0.0.1).
   ○ Write if each is IPv4 or IPv6 and its class (A, B, or C).
3. **Practice Subnetting**:
   ○ Use a calculator to find the number of devices in a subnet.
   ○ Example: For 192.168.1.0/24, calculate how many IP addresses are available (hint: 256).
   ○ Try dividing a network into two subnets (e.g., 192.168.1.0/25).
4. **Discuss**: Talk about why IP addresses are like phone numbers for devices.

Tips:

- Use the subnetting cheat sheet provided.
- Write down each step of your calculations.

Topic 4: Exploring Network Topologies

Goal: Understand different ways to arrange networks.

What You'll Learn:

- **Topology**: The layout of a network.
- **Star Topology**: Devices connect to a central switch (most common).
- **Bus Topology**: Devices share one cable (older, less common).
- **Ring Topology**: Devices form a loop (rare toTopic).

Lab Instructions:

1. **Learn Topologies**: Your teacher will show examples of star, bus, and ring topologies.
2. **Compare Topologies**:
   - Get a handout listing topologies.
   - Write one advantage (e.g., star is easy to fix) and one disadvantage (e.g., star needs a switch).
3. **Design a Star Topology**:
   - On paper, draw a network with a switch, four computers, and a router.
   - Label all devices and connections.
   - Show your drawing to your teacher.
4. **Discuss**: Talk about which topology you'd use for a school network and why.

Tips:

- Keep your drawing neat and labeled.
- Ask how topologies affect network speed.

Topic 5: Basic Network Troubleshooting

Goal: Learn to fix simple network problems.

What You'll Learn:

- **Troubleshooting**: Finding and fixing network issues.
- **Ping**: A command to test if devices can communicate.
- **Common Issues**: Loose cables, wrong IP addresses.

Lab Instructions:

1. **Learn Troubleshooting**: Your teacher will explain how to use ping and spot problems.
2. **Test Connectivity**:
   ○ Connect two computers with an Ethernet cable (provided).
   ○ On one computer, open the command prompt (Windows: type "cmd").
   ○ Type "ping [other computer's IP]" (e.g., ping 192.168.1.2).
   ○ Check if you get replies.
3. **Fix Problems**:
   ○ Your teacher will create issues (e.g., unplug a cable).
   ○ Use ping to test and find the problem (e.g., check cables, IP settings).
   ○ Write down what you did to fix it.
4. **Discuss**: Share what problems you found and how you solved them.

Tips:

● Write every step in your notebook.
● Ask for help if ping doesn't work.

Topic 6: Introduction to Packet Tracer

Goal: Learn to use Cisco Packet Tracer to build virtual networks.

What You'll Learn:

● **Packet Tracer**: A tool to simulate networks without real hardware.
● **Simulation**: Testing networks virtually.

Lab Instructions:

1. **Open Packet Tracer**:
   ○ Start Packet Tracer on your computer (your teacher will help install if needed).
   ○ Explore the toolbar (devices, cables, etc.).
2. **Build a Simple Network**:
   ○ Drag two PCs and one switch to the workspace.
   ○ Connect PCs to the switch with straight-through cables (click cable icon, select "Copper Straight-Through").
   ○ Click each PC, go to "Desktop" tab, then "IP Configuration."
   ○ Set PC1 to 192.168.1.1 and PC2 to 192.168.1.2 (subnet mask: 255.255.255.0).
3. **Test Connectivity**:
   ○ Click PC1, go to "Desktop" tab, open "Command Prompt."
   ○ Type "ping 192.168.1.2" and check for replies.
4. **Save Your Work**:
   ○ Save your file as "Topic6_Network.pkt" (File > Save).

    ○   Show your teacher.

Tips:

- Click carefully to avoid misplacing devices.
- Ask for help if the interface feels confusing.

Topic 7: Configuring a LAN in Packet Tracer

Goal: Build a Local Area Network (LAN) in Packet Tracer.

What You'll Learn:

- **LAN**: A network in one location (e.g., a classroom).
- **IP Configuration**: Setting IP addresses for devices.

Lab Instructions:

1. **Start a New Network**:
    - Open Packet Tracer and create a new file.
    - Add four PCs and one switch to the workspace.
    - Connect each PC to the switch with straight-through cables.
2. **Set IP Addresses**:
    - For each PC, go to "Desktop" > "IP Configuration."
    - Assign IPs: PC1 (192.168.1.1), PC2 (192.168.1.2), PC3 (192.168.1.3), PC4 (192.168.1.4).
    - Use subnet mask 255.255.255.0 for all.
3. **Test the LAN**:
    - From PC1, ping the other PCs (e.g., "ping 192.168.1.2").
    - Ensure all PCs can communicate.
4. **Save and Share**:
    - Save as "Topic7_LAN.pkt."
    - Show your teacher your file.

Tips:

- Double-check IP addresses for typos.
- If ping fails, check cable connections.

Topic 8: Introduction to Routers in Packet Tracer

Goal: Connect two LANs using a router in Packet Tracer.

What You'll Learn:

- **Router**: A device that connects different networks.
- **Interface**: A router port with its own IP address.

Lab Instructions:

1. **Build the Network**:
   - Add two switches, four PCs (two per switch), and one router.
   - Connect PCs to their switch, then each switch to the router.
2. **Configure IPs**:
   - LAN1 PCs: 192.168.1.1 and 1.2 (subnet mask: 255.255.255.0).
   - LAN2 PCs: 192.168.2.1 and 2.2 (subnet mask: 255.255.255.0).
   - Router interfaces: 192.168.1.254 (for LAN1) and 192.168.2.254 (for LAN2).
     - Click router, go to "Config" tab, set IPs under "GigabitEthernet0/0" and "GigabitEthernet0/1."
3. **Test Connectivity**:
   - From a PC in LAN1, ping a PC in LAN2 (e.g., "ping 192.168.2.1").
   - Ensure communication works.
4. **Save**: Save as "Topic8_Router.pkt."

Tips:

- Make sure the router interfaces are "on" (green light).
- Ask for help with router configuration.

Topic 9: Subnetting Practice in Packet Tracer

Goal: Design a network with subnets in Packet Tracer.

What You'll Learn:

- **Subnetting**: Dividing a network into smaller parts for efficiency.
- **Subnet Mask**: Defines the size of a subnet.

Lab Instructions:

1. **Plan Subnets**:
   - Your teacher will give you a network (e.g., 192.168.1.0/24).
   - Divide it into two subnets (e.g., 192.168.1.0/25 and 192.168.1.128/25).
2. **Build the Network**:
   - Add two switches, four PCs (two per switch), and one router.
   - Connect PCs to switches, switches to router.
3. **Assign IPs**:
   - Subnet 1 PCs: 192.168.1.1 and 1.2 (mask: 255.255.255.128).
   - Subnet 2 PCs: 192.168.1.129 and 1.130 (mask: 255.255.255.128).
   - Router interfaces: 192.168.1.126 and 192.168.1.254.
4. **Test and Save**:
   - Ping between subnets to verify.

○ Save as "Topic9_Subnets.pkt."

Tips:

- Use your subnetting cheat sheet.
- Check subnet masks carefully.

Topic 10: Introduction to DHCP in Packet Tracer

Goal: Set up a DHCP server to assign IPs automatically.

What You'll Learn:

- **DHCP**: A system that gives devices IP addresses automatically.
- **Dynamic IP**: An IP assigned by a server, not manually.

Lab Instructions:

1. **Build the Network**:
   ○ Add one switch, two PCs, and one router.
   ○ Connect PCs to switch, switch to router.
2. **Configure DHCP**:
   ○ Click router, go to "Config" tab, select "DHCP."
   ○ Create a pool named "LAN" with range 192.168.1.100–192.168.1.200 (mask: 255.255.255.0).
   ○ Set router interface to 192.168.1.1.
3. **Set PCs to DHCP**:
   ○ For each PC, go to "Desktop" > "IP Configuration," select "DHCP."
   ○ Check if PCs get IPs (e.g., 192.168.1.100).
4. **Test and Save**:
   ○ Ping between PCs to verify.
   ○ Save as "Topic10_DHCP.pkt."

Tips:

- Ensure the router's DHCP service is enabled.
- If PCs don't get IPs, check router settings.

Topic 11: VLAN Basics in Packet Tracer

Goal: Create Virtual LANs (VLANs) to separate network traffic.

What You'll Learn:

- **VLAN**: A way to group devices without physical separation.
- **Switch Ports**: Ports on a switch assigned to a VLAN.

Lab Instructions:

1. **Build the Network**:
   - Add one switch and four PCs.
   - Connect PCs to switch.
2. **Configure VLANs**:
   - Click switch, go to "CLI" tab.

Type:
enable
configure terminal
vlan 10
name SALES
vlan 20
name ENGINEERING
exit
interface fastEthernet0/1
switchport mode access
switchport access vlan 10
interface fastEthernet0/2
switchport mode access
switchport access vlan 10
interface fastEthernet0/3
switchport mode access
switchport access vlan 20
interface fastEthernet0/4
switchport mode access
switchport access vlan 20

   -
3. **Set IPs and Test**:
   - Assign PCs in VLAN 10: 192.168.10.1 and 10.2.
   - Assign PCs in VLAN 20: 192.168.20.1 and 20.2.
   - Ping within VLANs (should work) and between VLANs (should fail).
4. **Save**: Save as "Topic11_VLANs.pkt."

Tips:

- Copy CLI commands carefully.
- Ask why VLANs block inter-VLAN pings.

Topic 12: Static Routing in Packet Tracer

Goal: Set up static routes to connect networks.

What You'll Learn:

- **Static Route**: A manually set path for network traffic.
- **Routing Table**: A router's list of paths to other networks.

Lab Instructions:

1. **Build the Network**:
   - Add two switches, four PCs (two per switch), and two routers.
   - Connect PCs to switches, switches to routers, routers to each other.
2. **Configure IPs**:
   - LAN1 PCs: 192.168.1.1 and 1.2; Router1 interface: 192.168.1.254.
   - LAN2 PCs: 192.168.2.1 and 2.2; Router2 interface: 192.168.2.254.
   - Router-to-router link: 10.0.0.1 (Router1) and 10.0.0.2 (Router2).
3. **Add Static Routes**:

On Router1 (CLI):
enable
configure terminal
ip route 192.168.2.0 255.255.255.0 10.0.0.2

   -

On Router2 (CLI):
enable
configure terminal
ip route 192.168.1.0 255.255.255.0 10.0.0.1

   -
4. **Test and Save**:
   - Ping from LAN1 to LAN2.
   - Save as "Topic12_Routing.pkt."

Tips:

- Check router IPs if pings fail.
- Save often to avoid losing work.

Topic 13: Introduction to Wireless Networking

Goal: Set up a wireless network with security.

What You'll Learn:

- **Access Point**: A device that creates a wireless network.
- **WPA2**: A security method for wireless networks.

Lab Instructions:

1. **Build the Network**:
    - Add one wireless access point, one switch, and two PCs.
    - Connect access point to switch, PCs to wireless network.
2. **Configure the Access Point**:
    - Click access point, go to "Config" tab.
    - Set SSID to "ClassWiFi" and security to WPA2-PSK.
    - Set password to "Network123."
3. **Connect PCs**:
    - Click each PC, go to "Desktop" > "PC Wireless."
    - Select "ClassWiFi," enter password "Network123."
    - Set IPs (e.g., 192.168.1.1 and 1.2, mask: 255.255.255.0).
4. **Test and Save**:
    - Ping between PCs.
    - Save as "Topic13_Wireless.pkt."

Tips:

- Ensure PCs connect to the correct SSID.
- Check password if connection fails.

Topic 14: Network Security Basics

Goal: Use firewall rules to secure a network.

What You'll Learn:

- **Firewall**: Blocks unwanted network traffic.
- **Access Control List (ACL)**: Rules to allow or block traffic.

Lab Instructions:

1. **Build the Network**:
    - Add one switch, two PCs, and one router.
    - Connect PCs to switch, switch to router.

2. **Configure IPs**:
      ○ PCs: 192.168.1.1 and 1.2; Router interface: 192.168.1.254.
   3. **Set Up ACL**:

On router (CLI):
enable
configure terminal
access-list 101 deny ip 192.168.1.1 0.0.0.0 any
access-list 101 permit ip any any
interface fastEthernet0/0
ip access-group 101 in

      ○
   4. **Test and Save**:
      ○ From PC1 (192.168.1.1), ping PC2 (should fail).
      ○ From PC2, ping PC1 (should work).
      ○ Save as "Topic14_ACL.pkt."

Tips:

   ● Test ACLs carefully to understand rules.
   ● Ask how ACLs protect networks.

Topic 15: Troubleshooting Networks in Packet Tracer

Goal: Find and fix network problems in Packet Tracer.

What You'll Learn:

   ● **Troubleshooting Tools**: Ping, checking cables, and IP settings.
   ● **Common Issues**: Wrong IPs, disconnected cables.

Lab Instructions:

   1. **Get a Network**:
      ○ Your teacher will give you a Packet Tracer file with errors.
   2. **Find Problems**:
      ○ Use ping to test connectivity between PCs.
      ○ Check cables, IP addresses, and router settings.
   3. **Fix and Test**:
      ○ Correct issues (e.g., fix IPs, reconnect cables).
      ○ Ping again to confirm fixes.
   4. **Document**:
      ○ In your notebook, write the problems you found and how you fixed them.
      ○ Save the fixed file as "Topic15_Troubleshoot.pkt."

Tips:

- Start with ping to narrow down issues.
- Ask for hints if stuck.

Topic 16: Introduction to Network Protocols

Goal: Set up an HTTP server to learn about protocols.

What You'll Learn:

- **Protocol**: Rules for network communication (e.g., HTTP for websites).
- **HTTP Server**: A device that hosts web pages.

Lab Instructions:

1. **Build the Network**:
   - Add one switch, one server, and one PC.
   - Connect PC and server to switch.
2. **Configure IPs**:
   - PC: 192.168.1.1; Server: 192.168.1.2 (mask: 255.255.255.0).
3. **Set Up HTTP Server**:
   - Click server, go to "Services" tab, turn on "HTTP."
   - Add a simple webpage (default is fine).
4. **Test and Save**:
   - On PC, go to "Desktop" > "Web Browser," enter "192.168.1.2."
   - Check if the webpage loads.
   - Save as "Topic16_HTTP.pkt."

Tips:

- Use simulation mode to see HTTP traffic.
- Ensure the server's HTTP service is on.

Topic 17: DNS Configuration in Packet Tracer

Goal: Set up a DNS server to translate names to IPs.

What You'll Learn:

- **DNS**: Matches domain names (e.g., example.com) to IP addresses.
- **DNS Server**: A device that handles name resolution.

Lab Instructions:

1. **Build the Network**:
   ○ Add one switch, one server, and one PC.
   ○ Connect PC and server to switch.
2. **Configure IPs**:
   ○ PC: 192.168.1.1; Server: 192.168.1.2 (mask: 255.255.255.0).
3. **Set Up DNS**:
   ○ Click server, go to "Services" tab, turn on "DNS."
   ○ Add a record: Name = "example.com," Address = "192.168.1.2."
4. **Test and Save**:
   ○ On PC, go to "Desktop" > "Command Prompt," type "ping example.com."
   ○ Check if it resolves to 192.168.1.2.
   ○ Save as "Topic17_DNS.pkt."

Tips:

● Ensure DNS service is enabled.
● Check spelling of domain names.

Topic 18: NAT Configuration in Packet Tracer

Goal: Use NAT to connect a private network to a public one.

What You'll Learn:

● **NAT**: Translates private IPs to public IPs for internet access.
● **Private IP**: Used inside a network (e.g., 192.168.1.0).
● **Public IP**: Used on the internet (e.g., 203.0.113.1).

Lab Instructions:

1. **Build the Network**:
   ○ Add one switch, two PCs, one router, and one server (public network).
   ○ Connect PCs to switch, switch to router, router to server.
2. **Configure IPs**:
   ○ PCs: 192.168.1.1 and 1.2; Router LAN interface: 192.168.1.254.
   ○ Router WAN interface: 203.0.113.1; Server: 203.0.113.2.
3. **Set Up NAT**:

On router (CLI):
enable
configure terminal
access-list 1 permit 192.168.1.0 0.0.0.255
ip nat inside source list 1 interface fastEthernet0/1 overload
interface fastEthernet0/0
ip nat inside
interface fastEthernet0/1

ip nat outside

    ○

4. **Test and Save**:
    - ○ Ping server from PCs.
    - ○ Save as "Topic18_NAT.pkt."

Tips:

- Check NAT interfaces (inside/outside).
- Ensure ACL matches the LAN.

Topic 19: Capstone Project Setup

Goal: Start building a small office network with multiple services.

What You'll Learn:

- **Capstone Project**: A complete network with VLANs, DHCP, DNS, and NAT.
- **Planning**: Designing a network before building it.

Lab Instructions:

1. **Plan Your Network**:
    - ○ Get the project rubric from your teacher.
    - ○ On paper, sketch a network with two VLANs (Sales, Engineering), a router, a DNS server, and DHCP.
2. **Start Building**:
    - ○ Open Packet Tracer and add devices: two switches, four PCs, one router, one server.
    - ○ Connect devices based on your plan.
    - ○ Assign VLANs and IPs (e.g., VLAN 10: 192.168.10.0/24, VLAN 20: 192.168.20.0/24).
    - ○
3. **Configure Services**:
    - ○ Set up DHCP on the router for both VLANs.
    - ○ Configure DNS on the server for a domain (e.g., office.com).
4. **Save**: Save as "Topic19_Capstone.pkt."

Tips:

- Follow your plan step by step.
- Ask for help with complex setups.

Topic 20: Capstone Project Completion and Presentation

Goal: Finish and present your office network.

What You'll Learn:

- **Integration**: Combining all skills (VLANs, DHCP, DNS, NAT).
- **Presentation**: Explaining your network to others.

Lab Instructions:

1. **Finish the Network**:
   - Complete configurations from Topic 19.
   - Add NAT to connect your network to a public IP (e.g., 203.0.113.0/24).
   - Test all services: ping between VLANs (with routing), check DHCP, resolve DNS names.
2. **Prepare Presentation**:
   - Write a short explanation of your network (devices, services, IPs).
   - Practice showing your network in Packet Tracer.
3. **Present**:
   - Show your network to the class (5 minutes).
   - Demonstrate ping, DNS, and webpage access.
4. **Save**: Save as "Topic20_Capstone_Final.pkt."

Tips:

- Test everything before presenting.
- Speak clearly and explain your design choices.

Final Notes

- **Keep Your Notebook**: Write down what you do each Topic—it helps with troubleshooting and the capstone!
- **Ask Questions**: Networking can be tricky, so ask your teacher if you're stuck.
- **Have Fun**: You're learning skills used in real-world IT jobs!