



Birzeit University

Faculty of Engineering and Technology

Department of Electrical and Computer Engineering

ENCS3320 – Computer Networks (Term 1242)

**Project #2 (Cisco Packet Tracer) – Due Tuesday, June 17, 2025**

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## A) Objectives

This project aims to enhance your knowledge and practical skills in computer network design, including subnetting, routing, and essential network services such as Web, Email, Domain Name System (DNS), and Dynamic Host Configuration Protocol (DHCP). The specific objectives are:

- Design an IP addressing scheme using subnetting.
- Learn to use Cisco Packet Tracer to design and simulate network topologies.
- Develop skills in configuring and managing essential network services such as Web, Email, DNS, and DHCP servers.
- Learn the fundamentals of wireless Local Area Network (LAN) configuration.
- Achieve expertise in configuring IP addressing for network devices, including both static and DHCP setups, while ensuring accurate connectivity verification.
- Gain proficiency in using fundamental network commands.
- Develop professional technical report writing skills to effectively document and communicate project results and analyses.
- Strengthen teamwork skills through collaboration on project tasks.

## B) Requirements and Deliverables

As a team of *three students (from any section)*, your task is to design a network of networks using Cisco Packet Tracer and submit both your **.pkt** project file (named by **TeamName.pkt**) and a project report (**TeamName\_report.pdf**). Please adhere to the following guidelines:

- **Cisco Packet Tracer Installation:** Download the latest version of Cisco Packet Tracer from <https://www.netacad.com/cisco-packet-tracer>.
- **Implementation Guidelines:** Ensure that the implementation reflects *your work*. Refer to [Section D \(Helpful Tutorials\)](#) for resources to assist with creating the topology.
- **Team Coordination:** Active participation from each team member is essential at every stage of the project, including research, design, implementation, testing, and report preparation. To enhance collaboration, use [GitHub](#) for version control and coding, and [Overleaf](#) for real-time document editing. Clearly define responsibilities, maintain communication with regular feedback, and monitor progress closely to ensure a cohesive and successful project outcome.
- **Submission Requirements:** Submit the following **files** in a single compressed folder named **TeamName\_Project2.zip** through ( <https://itc.birzeit.edu/course/view.php?id=34254> ):

### 1) Project Report (**TeamName\_report.pdf**)

A comprehensive technical report in **PDF** format that documents your solutions. The report should include:

#### a. Cover Page

- Include the university logo, department, course name and number, project title, team members' names and IDs (with their sections), and submission date.

b. **Theory and Procedure**

- Explain the theoretical concepts relevant to each project requirement, organized under appropriate section titles.
- List the components or methods used for each part of the project, with a brief justification for each.
- Use diagrams or flowcharts to illustrate your solutions. Provide detailed descriptions and captions for all figures, ensuring they are referenced in the text.
- Cite all theoretical concepts and sources, and include a references section at the end of the report.

c. **Results and Discussions**

- Provide a detailed discussion of your approach and the results for each task outlined in [Section C \(Topology & Tasks\)](#).
- Include clear screenshots that demonstrate the functionality of all required tasks. **Each screenshot must display the system's date and time.** Accompany each screenshot with an explanation, detailing the results and their significance.

d. **Issues and Limitations**

- Highlight challenges, limitations, or issues encountered during the project, whether individual or team-related.
- Note any tasks or components that did not function as expected, if applicable.

e. **Teamwork**

- Use a chart to document each team member's contributions, detailing specific tasks completed by each individual.

Ensure the report includes proper numbering, a table of contents, a list of figures, a list of tables, and appendices as necessary.

2) **Network Topology** (*TeamName.pkt*)

Create the network topology shown in **Figure 1**, adhering to the following requirements:

a. Use the following **devices** in your implementation:

- |  |                                  |
|--|----------------------------------|
| ○ Routers ( <b>Router-PT</b> )           | ○ Switches ( <b>Switch-PT</b> )  |
| ○ Access Point ( <b>AccessPoint-PT</b> ) | ○ Servers ( <b>Server-PT</b> )   |
| ○ PCs/Laptops ( <b>PC-PT/Laptop-PT</b> ) | ○ Printers ( <b>Printer-PT</b> ) |
| ○ Smartphone ( <b>SMARTPHONE-PT</b> )    | ○ Tablet ( <b>TabletPC-PT</b> )  |
| ○ Central-Office-Server                  | ○ Cell-Tower                     |

b. Use **automatic connections** to link the devices.c. In the Home network, replace the laptop's wired LAN module with a **WPC300N** wireless adapter module to provide wireless connectivity with the access point.

Each team must submit **one** final version by **June 17, 2025**. **Late submissions will not be accepted** under any circumstances. Failure to submit your project solutions before the deadline will result in a score of zero.

**C) Topology & Tasks:**

The network topology comprises **five** areas: (i) Core network (**Area 0**), (ii) University network (**Area 1**), (iii) Street network (**Area 2**), (iv) Home network (**Area 3**), and (v) Datacenter network (**Area 4**). These networks are interconnected through the Core network, as depicted in **Figure 1**. For the IP setting for each network you are going to do the subnetting task. In the main IP (1**X**.**Y**.8.0/23), replace the variable **X** and **Y** with the last four digits of the team leader's student ID (SID). For example, if the team leader's SID is **1227090**, then **X = 70** and **Y = 90**, the IP will be in this example is **170.90.8.0/23**. Solutions that *fail to incorporate the SID* into the network IP addresses as specified will be deemed **invalid and rejected**. The project consists of the following major tasks:

1) **IP Subnetting Task:**

Create the necessary IP addressing and subnet plan using the specified address, the number of devices in **Table 1**, and the topology illustrated in **Figure 1**.

*Table 1: Number of hosts for each network.*

Network	Subnetwork	Hosts
Core	NET0-A	2
	NET0-B	2
	NET0-C	2
University	NET1-A	60
	NET1-B	60
Street	NET2	30
Home	NET3	20
Datacenter	NET4	15

Using the main IP address and the number of hosts in each network, compute the IP configuration for each subnetwork. A table should be included in your report showing the network IP, broadcast IP, range of usable IPs, and the corresponding CIDR notation (/X) for the subnet mask.

2) **Building Topology Task:**

The structure of the core network is shown in **Figure 1** and subnet IP addresses for this network should be assigned based on the results of **IP Subnetting Task**. Here the details of the networks:

a) **Core network (Area 0):**

It consists of three subnetworks (**NET0-A**, **NET0-B**, and **NET0-C**), follow these steps to build and configure the network:

1. Add three routers (Router-PT).
2. Turn on the interfaces and assign IPs.
3. Do the requested routing as in the **Routing Configuration Part**.

b) **University network (Area 1):**

It consists of two subnetworks (**NET1-A** and **NET1-B**), follow these steps to build and configure the network:

1. Each interface has an IP address based on the subnetting part.
2. Turn on the interfaces and assign IPs.
3. Add two switches (Switch-PT).
4. For subnetwork (**NET1-A**), on the first switch, add two PCs (PC-PT) and one DHCP server (Server-PT). The two PCs will get their IPs dynamically from the DHCP server (DHCP1). The configuration of the DHCP server as follows:
  - Enable only **DHCP** service.
  - Assign a **static** IP configuration.
  - Create pool and name it by *TeamName*:
    - Default Gateway: *IP address of the router.*
    - DNS Server: *IP address of the dns.coe.birzeit.edu server.*
    - Start IP Address: *First usable host IP address after excluding the first 10.*
    - Subnet Mask: *Network mask.*
    - Maximum Number of Users: *Total number of remaining usable host IP addresses after accounting for exclusions.*
5. For subnetwork (**NET1-B**), on the second switch, add access wireless point (AccessPoint-PT). To this wireless device, add one laptop (Laptop-PT), one tablet (TabletPC-PT), and one smartphone (Smartphone-PT). All these end devices will get their IPs wirelessly through the

access point. Here are the setting of the access point:

- Name: *ENCS3320TeamName*
- Security Model: *WPA2 Personal*
- Encryption Type: *AES*
- Key: *Home\_TeamName* (e.g., *Home\_T001*)

**c) Street network (Area 2):**

It consists of one network (**NET2**), follow these steps to build and configure the network:

1. Turn on the interface and assign IP.
2. Add CO server (Central-Office-Server) and connect it to the router interface.
3. Add cell tower (Cell-Tower), name the Provider by *TeamName*, and then connect it with the CO server.
4. Connect three smartphones to the cell tower.

**d) Home network (Area 3):**

It consists of one network (**NET3**), follow these steps to build and configure the network:

1. Turn on the interface and assign IP.
2. Add one switch (Switch-PT).
3. Add two PCs and assign IPs.

**e) Datacenter network (Area 4):**

It consists of one network (**NET4**), follow these steps to build and configure the network:

1. Turn on the interface and assign IP.
2. Add one switch (Switch-PT).
3. Add three servers and assign IPs.
4. The first server is web server, the second is DNS server, and the last one is email server. The configuration of these servers as explained next:

a. Web Server (*www.coe.birzeit.edu*)

- Enable only **HTTP** and HTTP Secure (**HTTPS**) protocols.
- Assign a **static** IP configuration.
- Customize the *index.html* page to include:
  - Tab Title: “COE-Birzeit”
  - Page Title: “Faculty of Engineering and Technology”
  - A description of the faculty, details about the team members, *images*, lists, and formatted text.

b. Mail Server (*mail.coe.birzeit.edu*)

- Enable only the **SMTP** (for sending emails) and **POP3** (for receiving emails).
- Assign a **static** IP configuration.
- Set the **domain name** (mail server alias hostname) as *coe.birzeit.edu*.
- Create *three* user accounts (one user in each networks i.e. home, street, and university) for team members as follows:
  - Username: {**HomeSID**, **StreetSID**, **UniversitySID**}.
  - Password: *Team member's SID*

The email address will follow this format: *Username@coe.birzeit.edu*

c. DNS Server (*dns.coe.birzeit.edu*)

- Enable only **DNS** service.
- Assign a **static** IP configuration.
- Add the recourse records (**RRs**) as in the **Table 2**.

*Table 2: DNS RRs.*

Name	Value	Type
www.coe.birzeit.edu	The IP address of the <i>www.coe.birzeit.edu</i> server	A
mail.coe.birzeit.edu	The IP address of the <i>mail.coe.birzeit.edu</i> server	A
coe.birzeit.edu	mail.coe.birzeit.edu	CNAME

These RRs map the Web server *www.coe.birzeit.edu* to the respective IP address. Additionally, they set the DNS server to resolve the alias hostname *coe.birzeit.edu* to its corresponding canonical name *mail.coe.birzeit.edu*.

### 3) Routing Configuration Task:

- Use open shortest path first (**OSPF**) for *routing* on the five given areas in the topology (**Area 0, Area 1, Area2, Area3, and Area 4**). You need to do the following on all routers:
  - a. Configuring OSPF on a router:
    - **Router(config)# router ospf <Process-ID>**  
This command starts the OSPF routing process with the process number *Process-ID*. It is recommended to use the value **1** for the process number on all routers.
  - b. Adding networks to the OSPF protocol:
    - **Router(config-router)# network <ID-Address> <Wildcard-Mask> area <Area-ID>**  
This command defines an interface on which OSPF runs and defines the area ID for that interface.

### 4) Testing and Troubleshooting Task:

You need to do the following and show them in your report:

- a) Include labels on the topology in the .pkt file for clarity.
- b) Include the following screenshots in your project report:
  - Static IP configuration for *routers*.
  - Dynamic IP configuration for the assigned end devices.
  - Static IP configuration for the assigned end devices.
  - Successful Ping and tracert results between end devices.
  - IP configuration of Web, Email, DNS, and DHCP servers.
  - Email service with the user setup on the *mail.coe.birzeit.edu*.
  - DNS service with the RRs on the *dns.coe.birzeit.edu*.
  - Successful access to the webserver *www.coe.birzeit.edu* from some of the end devices.
  - Email client configuration for *coe.birzeit.edu* account.
  - Successful sending and receiving of emails between the users from different networks.

## D) Helpful Tutorials

- Cisco Packet Tracer download and installation:
  - <https://www.youtube.com/watch?v=5dqZ623N7U4>
- Access Point and DHCP configuration:
  - <https://www.youtube.com/watch?v=-E4yivI26SY>
- DHCP, DNS, and Web servers configuration:
  - <https://www.youtube.com/watch?v=ZTNwwvT7S8>
- Email server configuration:
  - <https://www.youtube.com/watch?v=RWGw7hcNyNA>
  - <https://www.youtube.com/watch?v=rH0IHbeWw4o>
- Cell Tower + CO Server configuration:
  - <https://www.youtube.com/watch?v=-QVsWRdjiv4>
  - <https://www.youtube.com/watch?v=T3s9jIqmcSE>
- OSPF routing configuration:
  - <https://www.youtube.com/watch?v=1iJ882Xqqm0>

## E) Grading Criteria

This project constitutes **8%** of the total course grade. **Table 3** outlines the detailed grading criteria. Performance on this project will be evaluated competitively based on the following achievements:

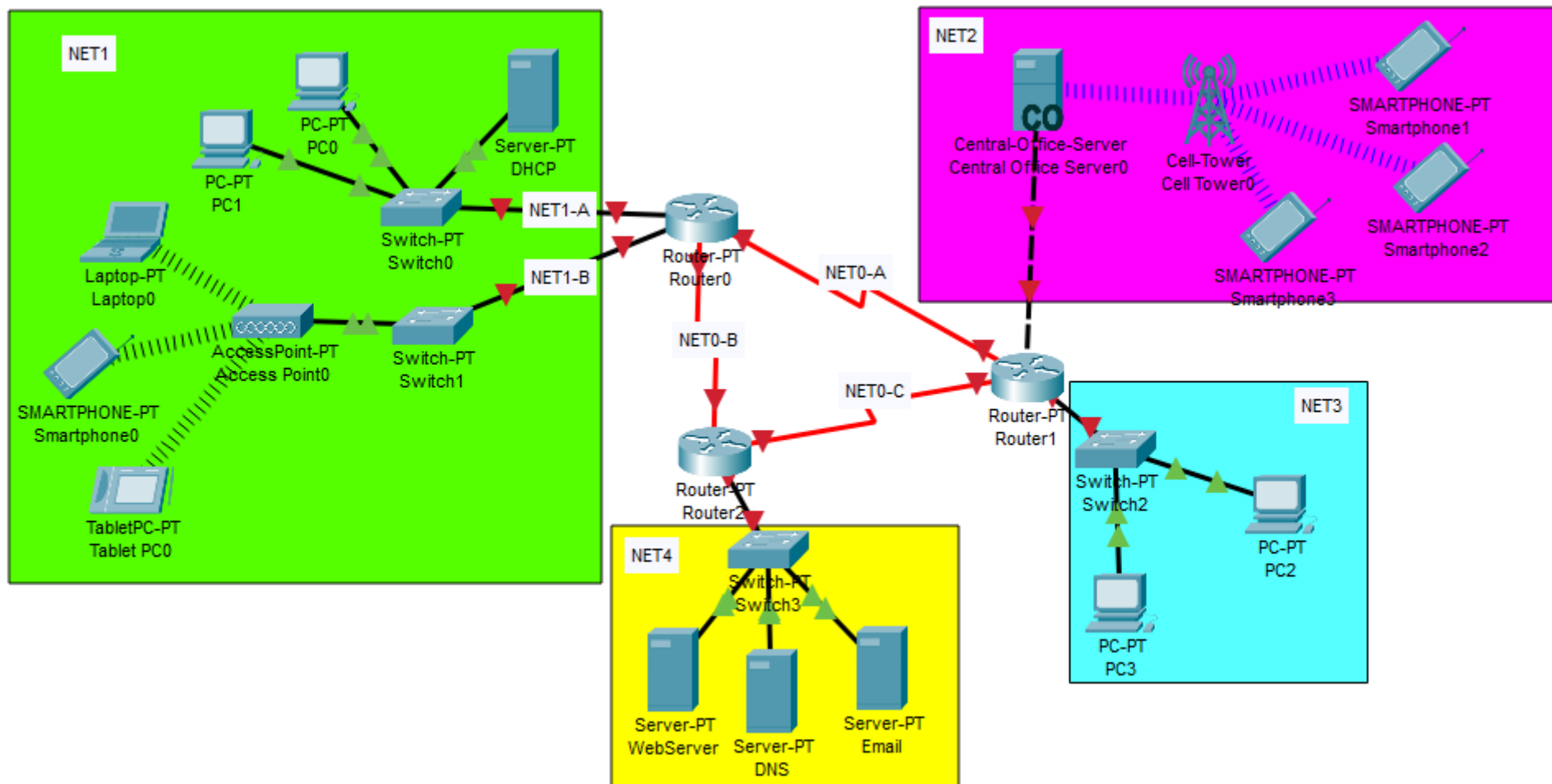
- A professional and visually appealing design for the web server's index page, incorporating advanced HTML/CSS features.
- Precise calculation and documentation of IP address usage, including reserved space and provisions for future expansion.
- Accurate and efficient configuration of routing protocol (OSPF), demonstrating clear evidence of seamless connectivity across all networks.
- Detailed analysis of DNS, SMTP, and POP3 message flows, supported by packet captures or logs that explain the processes comprehensively.
- Comprehensive screenshots paired with clear, detailed explanations for each configuration step.
- Inclusion of troubleshooting procedures and resolutions for any issues encountered throughout the project.
- Thorough and insightful explanations for email retrieval success or failure across devices, backed by evidence.
- Submission of a structured, professional project report with well-organized sections, detailed diagrams, and proper labels.
- Demonstrated collaborative teamwork with clear evidence of each member's unique contributions.

*Table 3: Grading Criteria.*Use **X,Y** in IP configuration:      A) True      B) False

Subject	Sub-Subject	Points	Remarks
<b>Report</b>	File name and extension	<b>2</b>	
	Cover page, numbering, table of contents, list of figures, list of tables, references, and appendices		
	Theory (DHCP, Web, Email, DNS, OSPF)		
	Subnetting		
	Results and discussion		
	Issues and limitations		
	Teamwork (Ratios and details)		
<b>Core Network</b>	Connect devices	<b>0.5</b>	
	Static IP configuration and Turn ON interface(s)		
	OSPF routing		
<b>University Network</b>	Connect devices	<b>1</b>	
	Static IP configuration and Turn ON interface(s)		
	DHCP server configuration		
	Static and dynamic IP configuration for end devices		
	Access point configuration		
	OSPF routing		
<b>Street Network</b>	Connect devices	<b>1</b>	
	Static IP configuration and Turn ON interface(s)		
	CO and Cell Tower configuration		
	IP configuration for end devices		
	OSPF routing		
<b>Home Network</b>	Connect devices	<b>0.5</b>	
	Static IP configuration and Turn ON interface(s)		
	IP configuration for end devices		
	OSPF routing		
<b>Datacenter Network</b>	Connect devices	<b>2</b>	
	Static IP configuration and Turn ON interface(s)		
	Web server configuration		
	Email server configuration (IP, service, domain, and accounts)		
	DNS server configuration (IP, service, and RRs)		
	Email clients configuration (in Home, Street, University networks)		
	OSPF routing		
<b>Testing</b>	Add labels	<b>1</b>	
	Connectivity		
	Access to the website		
	Sending and receiving emails		
<b>Total Points</b>		<b>8</b>	

**GOOD LUCK**





*Figure 1: Network Topology.*