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## **EXPERIMENT NO.: 09**

**AIM:** To design and simulate static NAT on the router using Cisco packet tracer.

### **THEORY:**

- **Definition of static NAT:**

Static NAT (Network Address Translation) is a type of NAT where a specific private IP address is mapped to a specific public IP address. This one-to-one mapping allows external devices to communicate with internal devices using a fixed public IP address.

- **How Static NAT Works**

- **Mapping:** In static NAT, a specific internal (private) IP address is directly associated with a specific external (public) IP address. For example, if a web server has a private IP of 192.168.1.10, you might configure static NAT to map it to a public IP like 203.0.113.10.
- **Request Handling:** When a request is made to the public IP (203.0.113.10), the NAT device translates it to the private IP (192.168.1.10) so that the request reaches the intended internal server.

- **Key Points:**

1. **Fixed Mapping:** Each private IP address has a corresponding public IP address that doesn't change. This is useful for servers or services that need a consistent address for external access.
2. **Accessibility:** It allows external clients to access services hosted on an internal network, such as web servers or email servers.
3. **No Port Translation:** Unlike Port Address Translation (PAT), which maps multiple private IP addresses to a single public IP address using different ports, static NAT maintains a direct one-to-one relationship.
4. **Use Cases:** Commonly used for hosting servers that need to be reliably reachable from the internet, such as websites, VPNs, or other services.
5. **Security Considerations:** While static NAT can help in managing IP addresses, it doesn't inherently provide security. Proper firewall and access control measures are still necessary.

- **Benefits of Static NAT**

1. **Consistency:** Since the mapping is fixed, external users can reliably connect to the same IP address every time, which is crucial for DNS settings and other configurations.
2. **Ease of Management:** Static NAT makes it straightforward to manage external access to internal resources, especially for servers that host services.
3. **No Port Overlap:** With static NAT, there's no confusion or overlap with port numbers, simplifying the routing of traffic.
4. **Simple Troubleshooting:** The predictable mapping aids in troubleshooting network issues, as administrators can quickly identify where traffic is going.

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- Limitations of Static NAT

1. **IP Address Consumption:** Static NAT consumes public IP addresses, which can be a limited resource. For each internal device requiring access, a separate public IP is needed.
2. **Cost:** Acquiring public IP addresses can be costly, particularly if you're dealing with multiple devices that require static mappings.
3. **Not a Security Measure:** While static NAT can obscure internal IP addresses, it should not be relied upon as a security mechanism. Firewalls and additional security measures are still necessary.
4. **Scalability:** For large networks with many devices needing internet access, managing static NAT can become cumbersome and complex.

- Practical Applications

1. **Web Servers:** Hosting websites where users need to access them via a consistent public IP address.
2. **VPN Gateways:** Providing secure access to internal resources while maintaining a constant point of entry.
3. **Email Servers:** Allowing external clients to send emails to a specific internal server without changing its address.
4. **IoT Devices:** Ensuring that specific IoT devices can be reliably accessed externally.

- Example of a VLAN:

Imagine a small business with a web server that hosts their company website. The internal network uses private IP addresses, and the business wants the web server to be accessible from the internet.

*Network Setup*

- **Internal Web Server:**
  - Private IP Address: 192.168.1.10
- **Public IP Address:**
  - Assigned to the router/firewall: 203.0.113.5

Static NAT Configuration

1. **Mapping:** The network administrator sets up a static NAT rule on the router to map the internal IP address of the web server to the public IP address:
  - **Internal IP:** 192.168.1.10 (Web Server)
  - **Public IP:** 203.0.113.5 (Router's external address)
2. **Traffic Flow:**
  - When a user from the internet wants to access the company's website, they type `http://203.0.113.5` into their browser.
  - The router receives the request on its public IP address (203.0.113.5).
  - The router uses the static NAT rule to translate this public IP address back to the internal IP address (192.168.1.10) of the web server.
  - The request is forwarded to the web server, which processes it and sends the response back through the router, maintaining the same NAT mapping.

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### Benefits

- **Consistent Access:** Users can always reach the web server at the same public IP address (203.0.113.5), which simplifies DNS configuration and makes it easier for clients to connect.
- **Simplicity:** The static NAT mapping is straightforward to manage and understand, which helps in troubleshooting.

### Use Case Summary

In this example, static NAT allows the internal web server to be reachable from the internet using a specific public IP address. This setup is common for businesses that need reliable access to their services without frequently changing IP addresses.

- What are the advantages of VLAN?

Here are the important pros/benefits of static NAT:

1. Static NAT provides a fixed mapping between a private IP address and a public IP address, ensuring that external users can always reach internal resources at the same address.
2. With predictable mappings, network administrators can easily manage and document the network configuration, reducing confusion and making troubleshooting simpler.
3. Services that require a stable IP address (like web servers, email servers, or VPNs) benefit from static NAT, as they don't have to deal with changing addresses.
4. Unlike Port Address Translation (PAT), static NAT maintains a one-to-one mapping without port number changes, eliminating potential conflicts and simplifying routing.
5. Reliable access to services is crucial for business operations. Static NAT ensures that clients can always find the resources they need without interruption.
6. Certain applications that require consistent IP addresses (like VoIP or certain gaming services) can perform better with static NAT since there's no need for dynamic address changes.
7. DNS records can point directly to a static public IP, making it easier to manage domain names and ensuring that users can reliably connect.
8. While static NAT itself isn't a security feature, it can help hide internal network structure by not exposing private IP addresses directly. Combined with firewalls, it can enhance security.
9. With fixed mappings, it's easier to identify and resolve connectivity issues, as the relationship between internal and external addresses remains constant.

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### **STEPS:**

Here's a step-by-step guide to design and simulate static NAT on a router using Cisco Packet Tracer:

Topology:

1. Create a new project in Cisco Packet Tracer.
2. Add the following devices:
  - Router (e.g., 2811)
  - Two PCs (inside network): PC-A (192.168.1.10) and PC-B (192.168.1.20)
  - One PC (outside network): PC-C (203.0.113.10)
3. Connect devices:
  - PC-A and PC-B to Router's FastEthernet0/0 (inside interface)
  - PC-C to Router's FastEthernet0/1 (outside interface)

Static NAT Configuration:

1]

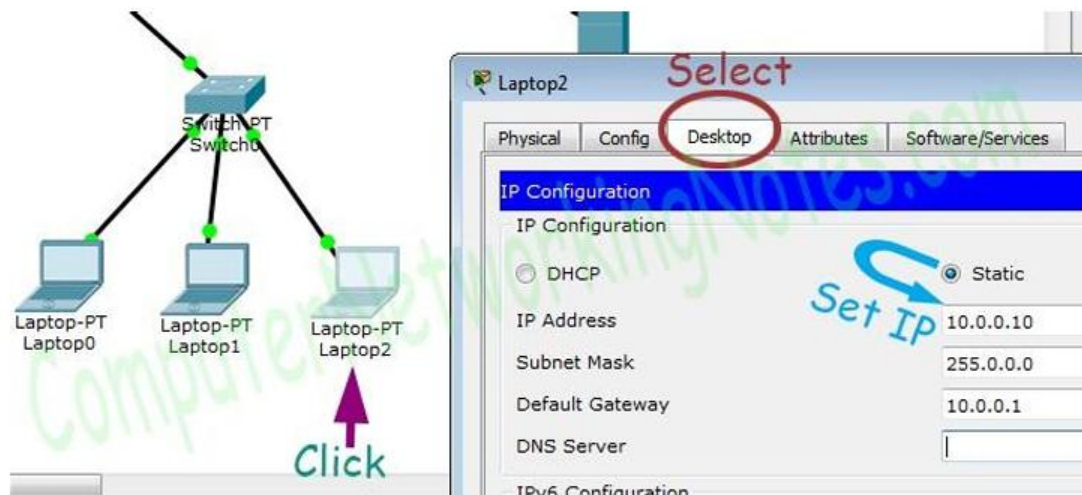
**Initial IP Configuration**

Device / Interface	IP Address	Connected With
Laptop0	10.0.0.10/8	Fa0/0 of R0
Laptop1	10.0.0.20/8	Fa0/0 of R0
Laptop2	10.0.0.30/8	Fa0/0 of R0
Server0	192.168.1.10/24	Fa0/0 of R1
Serial 0/0/0 of R1	100.0.0.1/8	Serial 0/0/0 of R2
Serial 0/0/0 of R2	100.0.0.2/8	Serial 0/0/0 of R2

2]

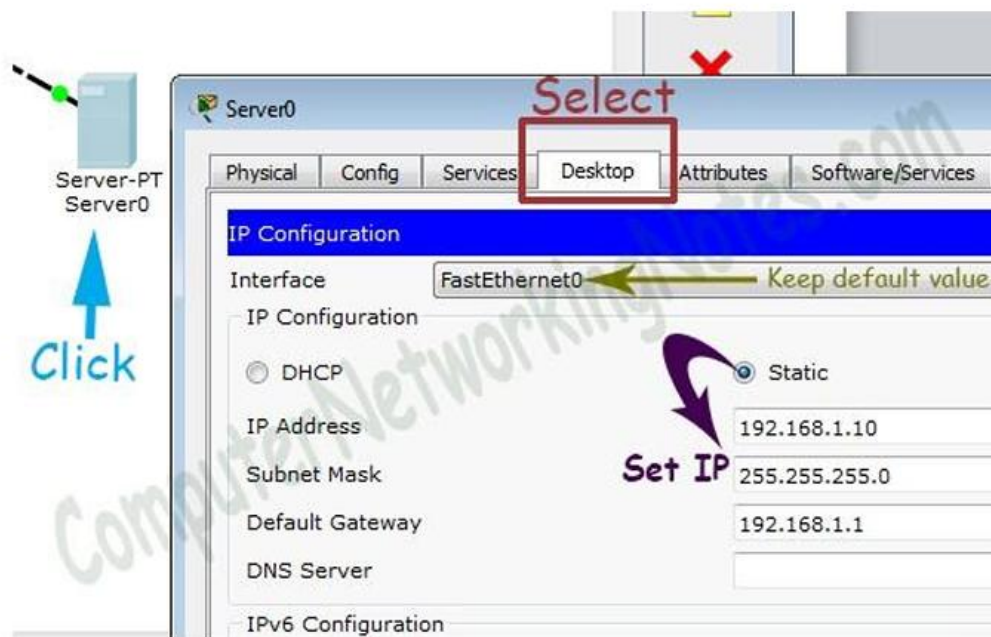
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To assign IP address in Laptop click Laptop and click Desktop and IP configuration and Select Static and set IP address as given in above table.



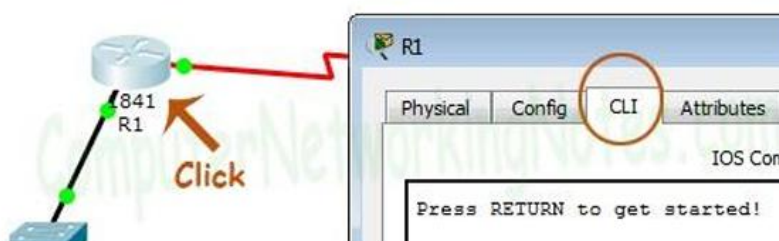
3]

Following same way configure IP address in Server.



4]

To configure IP address in Router1 click Router1 and select CLI and press Enter key.



CLI:- Router>enable

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### 1. Router configuration:

- Enable NAT: configure terminal > ip nat
- Define inside interface: ip nat inside source static 192.168.1.10 203.0.113.100
- Define outside interface: ip nat outside
- Save configuration: write memory

### Example configuration:

```
Router#configure terminal
```

```
Router(config)#ip nat
```

```
Router(config)#ip nat inside source static 192.168.1.10 203.0.113.100
```

```
Router(config)#interface FastEthernet0/0
```

```
Router(config-if)#ip nat inside
```

```
Router(config-if)#exit
```

```
Router(config)#interface FastEthernet0/1
```

```
Router(config-if)#ip nat outside
```

```
Router(config-if)#exit
```

```
Router(config)#end Router#write
```

```
memory
```

### Simulation:

1. Ping from PC-A (inside) to PC-C (outside): PC-A > Desktop > Command Prompt > ping 203.0.113.10
2. Verify NAT translation: Router > CLI > show ip nat translations
3. Verify connectivity: PC-C > Desktop > Command Prompt > ping 203.0.113.100 (should respond from PC-A)

### Tips and Variations:

1. Use show ip nat statistics to view NAT stats.
2. Configure multiple static NAT entries for different inside hosts.
3. Experiment with dynamic NAT or PAT (Port Address Translation).
4. Test NAT with different protocols (e.g., HTTP, FTP).
5. Use Wireshark to capture and analyze NAT traffic.

### Troubleshooting:

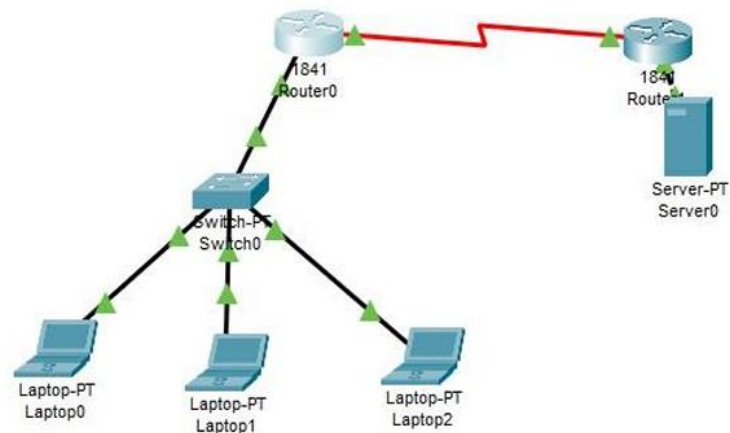
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1. Check NAT configuration and interface assignments.
2. Verify IP addressing and routing.
3. Use debug ip nat to troubleshoot NAT issues.

By following these steps, you'll successfully design and simulate static NAT on a router using Cisco Packet Tracer



**CONCLUSION:** In summary, static NAT is useful for situations where consistent external access to internal resources is required.