ENCS4130
Computer Networks Laboratory

EXP#10 Internet Protocol Version 6 (IPv6) Configuration

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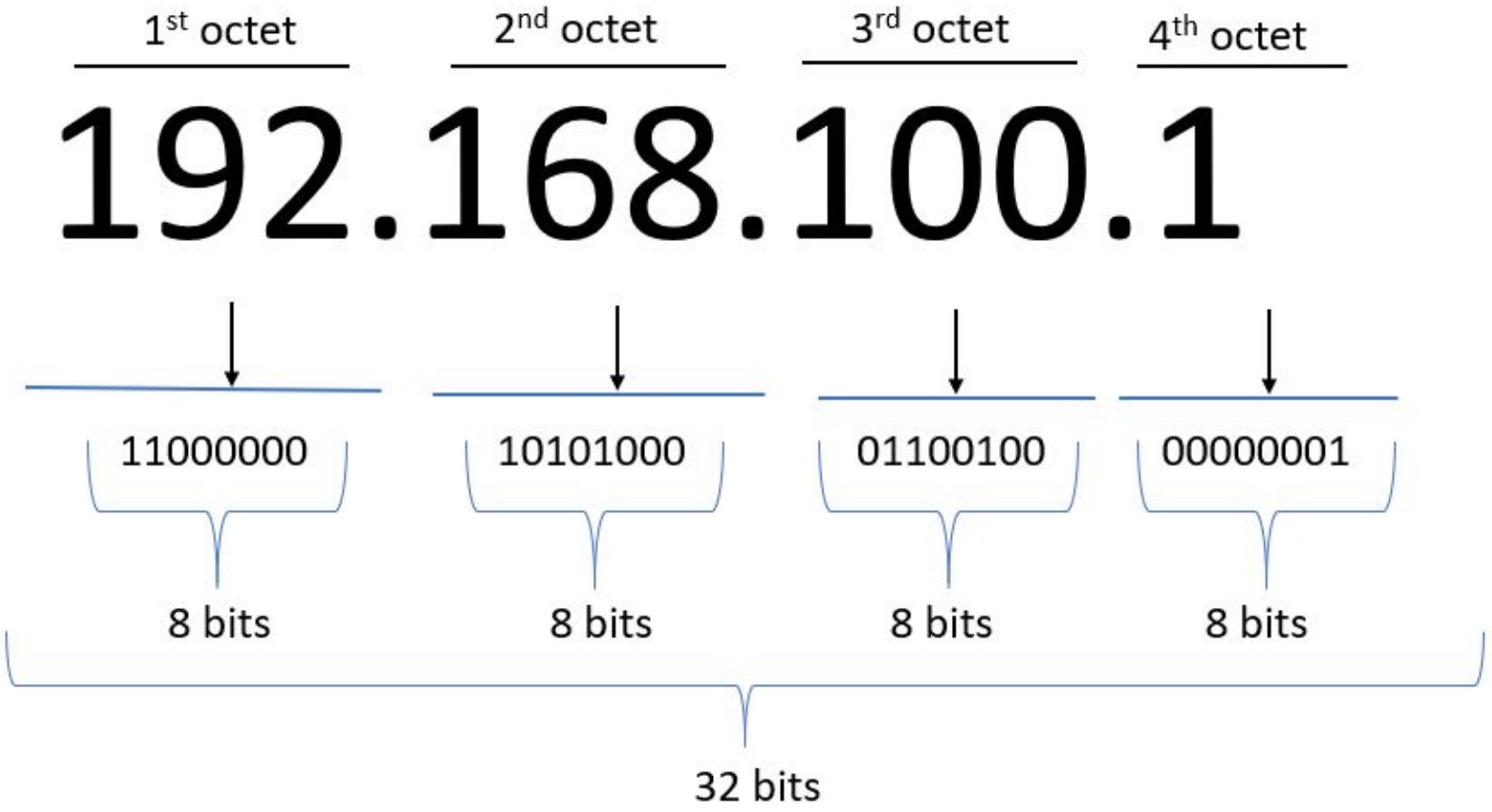
Objectives

- Learn how to configure a Cisco IOS router using the IOS command-line interface (CLI).
- Learn how to use router simulator.
- Learn how to configure and verify IPv6 routing with Cisco routers.
- Static IPv6 routing.
- Dynamic routing RIPng.

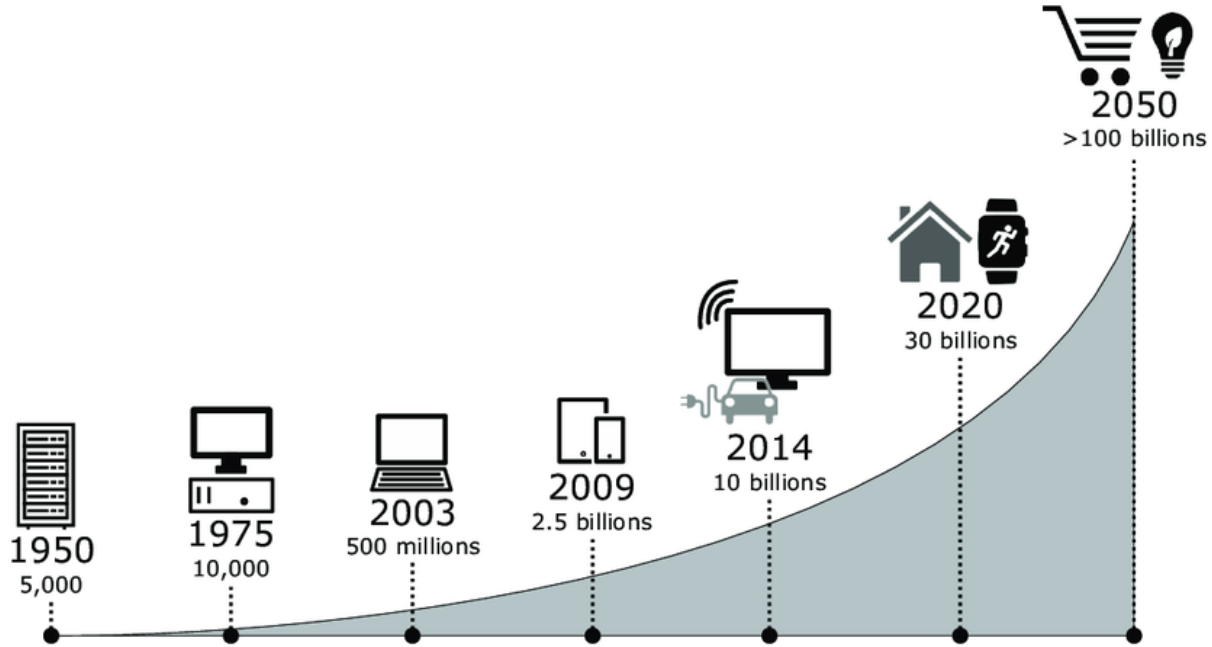
IPv4



- **IPv4 Addresses:** 2^{32} = ~4.3 billion unique addresses.

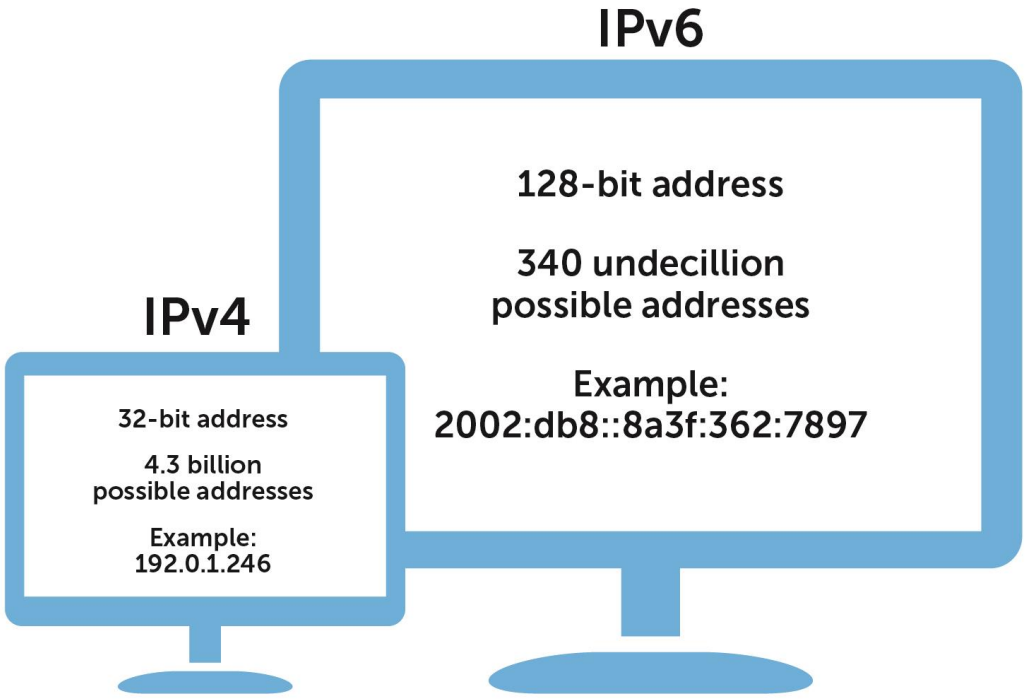
Why Do We Need IPv6?

- **IPv4 is Out of Addresses**
  - IPv4 can’t support the growing number of devices.
- **IPv6 Offers Unlimited Space**
  - Provides billions of times more addresses than IPv4.
- **Better Performance**
  - Making networks faster and simpler.
- **Built-in Security**
  - Includes encryption and authentication features.
- **Future-Proof**
  - Supports new technologies like IoT and 5G.



IPv6

- **128-bit Addressing Scheme:**
  - Total: 3.4 × 10^{38} addresses.
- **Example:**
  - AA76:0000:0000:0000:0012:A322:FE33:2267.
- **Hexadecimal Format:**
  - Groups of 4 hex digits separated by colons (:).



IPv6 (Cont.)

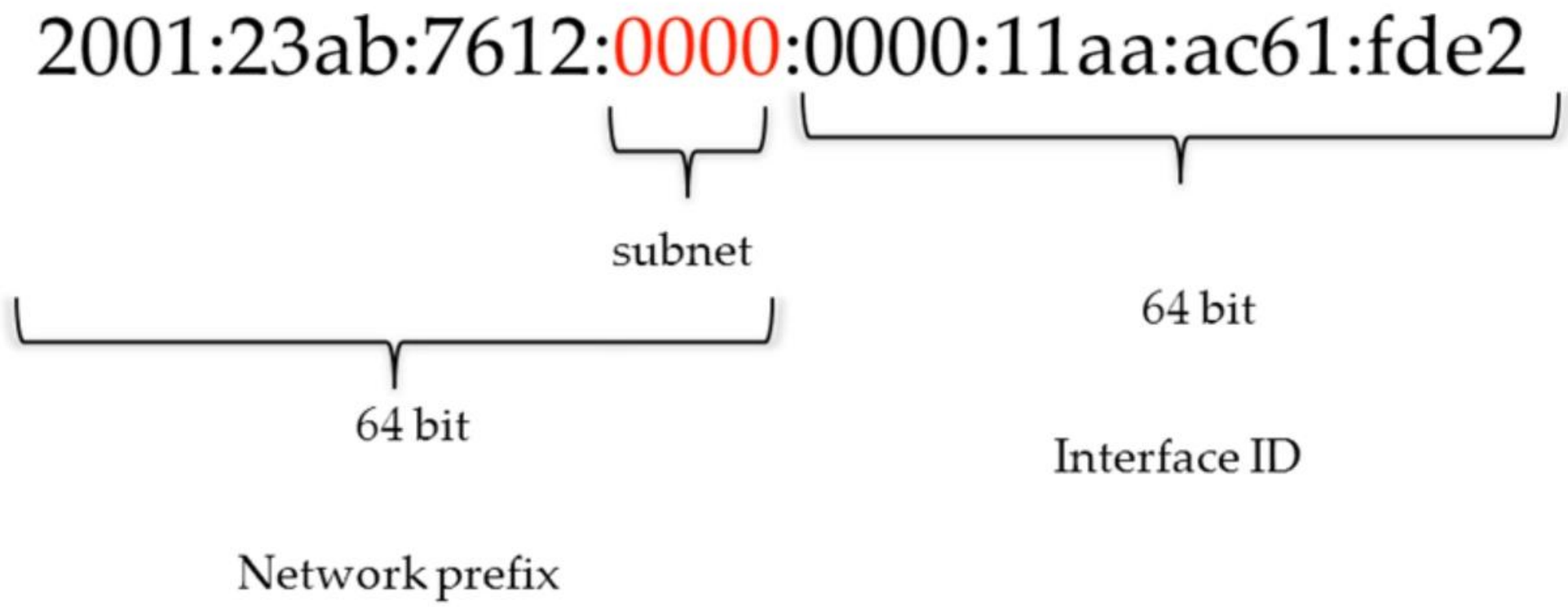
2001 : 0DC8 : E004 : 0001 : 0000 : 0000 : 0000 : F00A

16 bits : 16 bits : 16 bits : 16 bits : 16 bits : 16 bits : 16 bits : 16 bits

128 Bits

- **IPv6 Addresses:** 2^{128} =~ 3.4 x 10^{38} unique addresses.

IPv6 (Cont.)



IPv6 Address Simplification

- **Leading Zeros Removal:**
  - Before: AA76:0000:0000:0000:0012:A322:FE33:2267
  - After: AA76:0:0:0:12:A322:FE33:2267

- **Consecutive Zeros Compression (Use :: once per address):**
  - Before: AA76:0000:0000:0000:0012:A322:FE33:2267
  - After: AA76::12:A322:FE33:2267

IPv6 Address Simplification Example

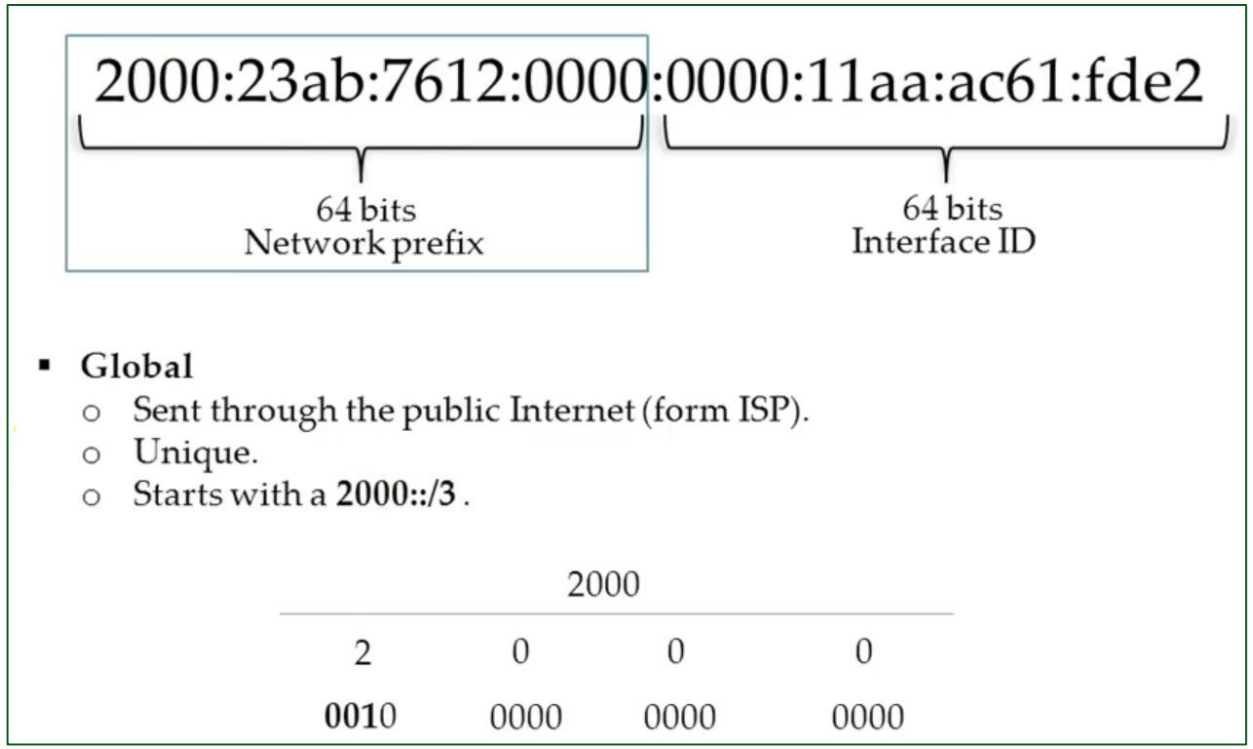
- **Which address simplifications are valid for AA76:0000:0000:0012:A322:0000:0000:2267**

Address Simplifications	Valid?
AA76::12:A322:0:0:2267	Valid
AA76:0:0:12:A322::2267	Valid
AA76::12:A322::2267	Invalid

- **What is the address simplification for 0000:0000:0000:0000:0000:0000:0000:0000**
  - **::**
- **What is the address simplification for 0000:0000:0000:0000:0000:0000:0000:0001**
  - **::1**

IPv6 Address Types

1. **Unicast (One to One): Delivered to a single interface.**
   - **Global Unicast:**
     - Equivalent to IPv4 public addresses.
     - Range: 2000::/3 (Globally routable)
   - **Link-Local:**
     - Equivalent to IPv4 private addresses.
     - Range: FE80::/10 (Not routed, local use only).



IPv6 Address Types

2. **Multicast (One to Many)**
   - Packets delivered to all interfaces tuned to the multicast address.
   - Supports one-to-many communication.
   - Range: FF00::/8
   -

Reserved Multicast Address	Description
FF02::1	All nodes on a link (broadcast).
FF02::2	All routers on a link
FF02::9	All (RIP) routers on a link

3. **Anycast (One to Nearest)**
   - Identifies multiple interfaces on multiple devices.
   - Delivered to the closest device based on routing distance.

Reserved IPv6 Addresses

- **Loopback Address**
  - ::1 (Equivalent to 127.0.0.1 in IPv4, used for testing locally)
- **IPv4-Mapped IPv6 Address**
  - ::192.X.100.1 (Used in IPv6/IPv4 mixed networks)
- **Global Unicast Address Range**
  - 2000::/3 (Globally routable public addresses)
- **Link-Local Address Range**
  - FE80::/10 (Used for local communication, not routable)

Configuring Cisco Routers with IPv6

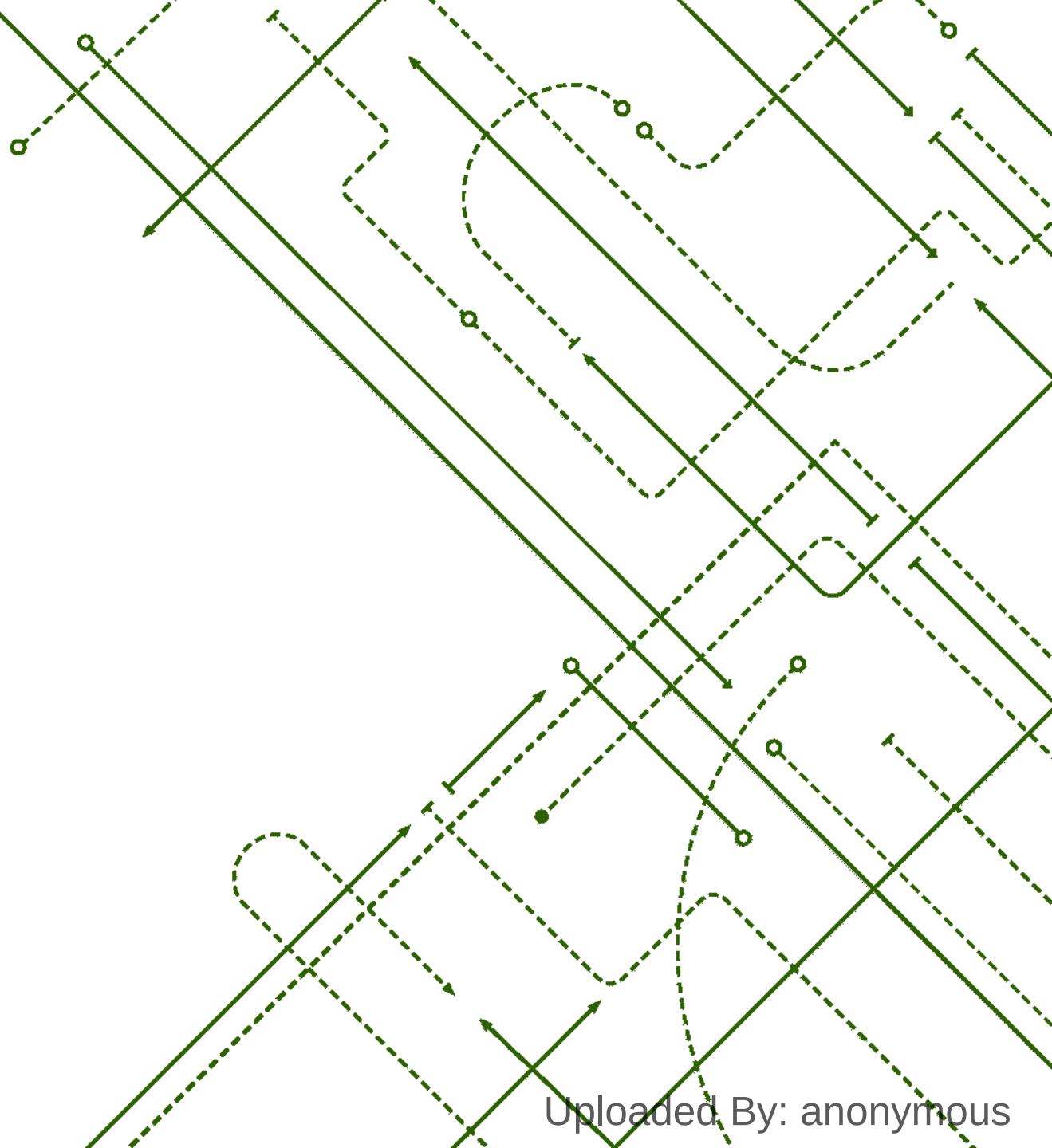
- **Assigning IPv6 Address to an Interface:**
  - (An interface can have multiple IPv6 addresses assigned.)
  - **Router(config)# interface <TYPE> <SLOT>/<PORT>**
  - **Router(config-if)# ipv6 address <IPV6-PREFIX>/<PREFIX-LENGTH>**
- **Enabling IPv6 Routing:**
  - (Enables IPv6 forwarding, which is disabled by default.)
  - **Router(config)# ipv6 unicast-routing**
- **Enabling Static Routing:**
  - (Directs traffic to the next-hop address for specified destination.)
  - **Router(config)# ipv6 route <IPV6-PREFIX>/<PREFIX-LENGTH> <IPV6-NEXT-HOP-ADDRESS>**

Configuring Cisco Routers with IPv6 (Cont.)

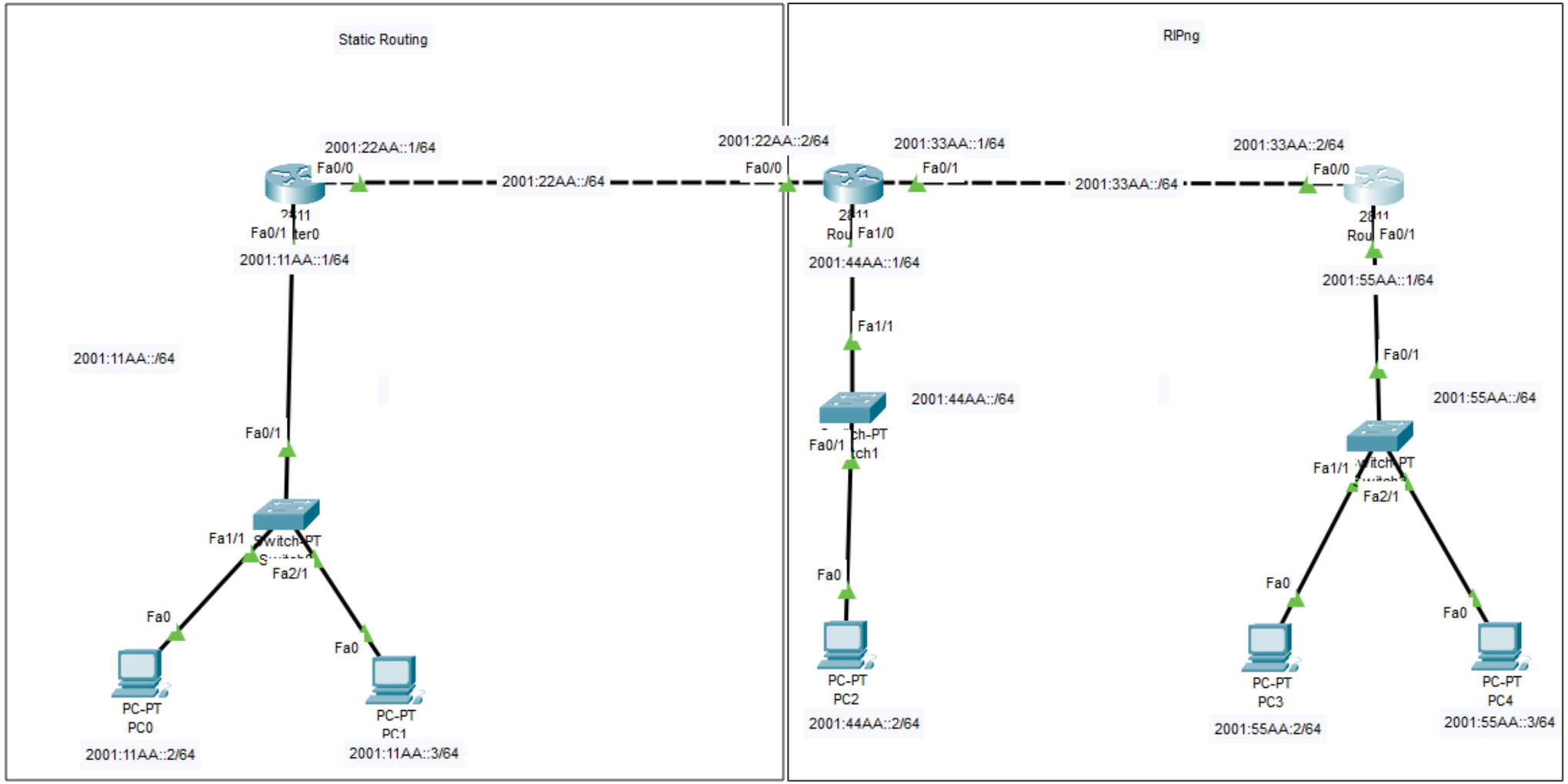
- **Enabling RIPng (Routing Information Protocol Next Generation):**
  - (Starts a new RIPng process directly from interface config mode.)
  - **Router(config)# interface <TYPE> <SLOT>/<PORT>**
  - **Router(config)# ipv6 rip <RIP-ID> enable**

- **Cisco Discovery Protocol (CDP):**
  - CDP is a device-discovery protocol that operates on all Cisco devices.
  - It helps to discover directly connected Cisco devices and exchange information like OS version and IP address.

Procedure



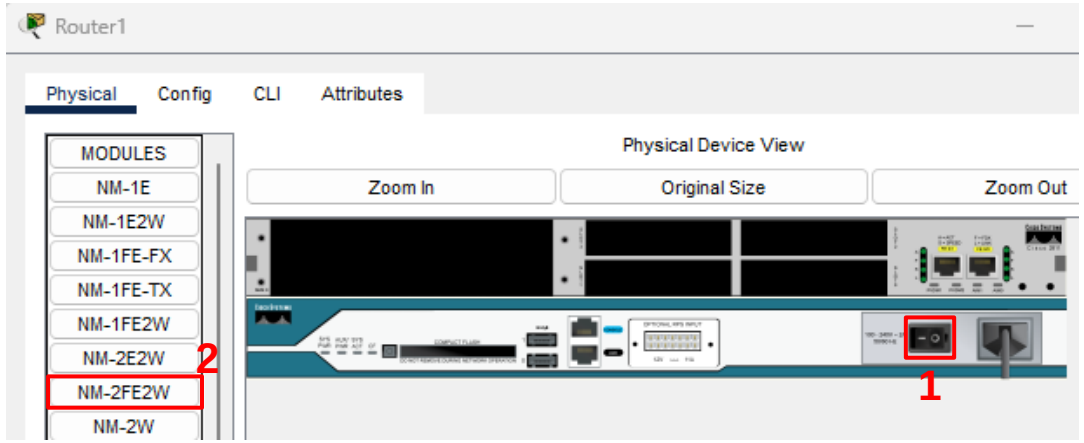
Topology

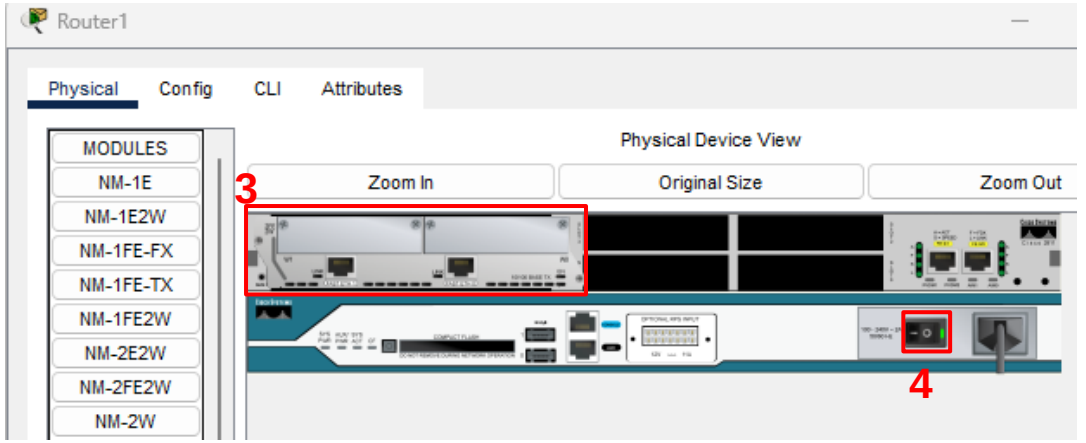


Step 1: Build the Topology

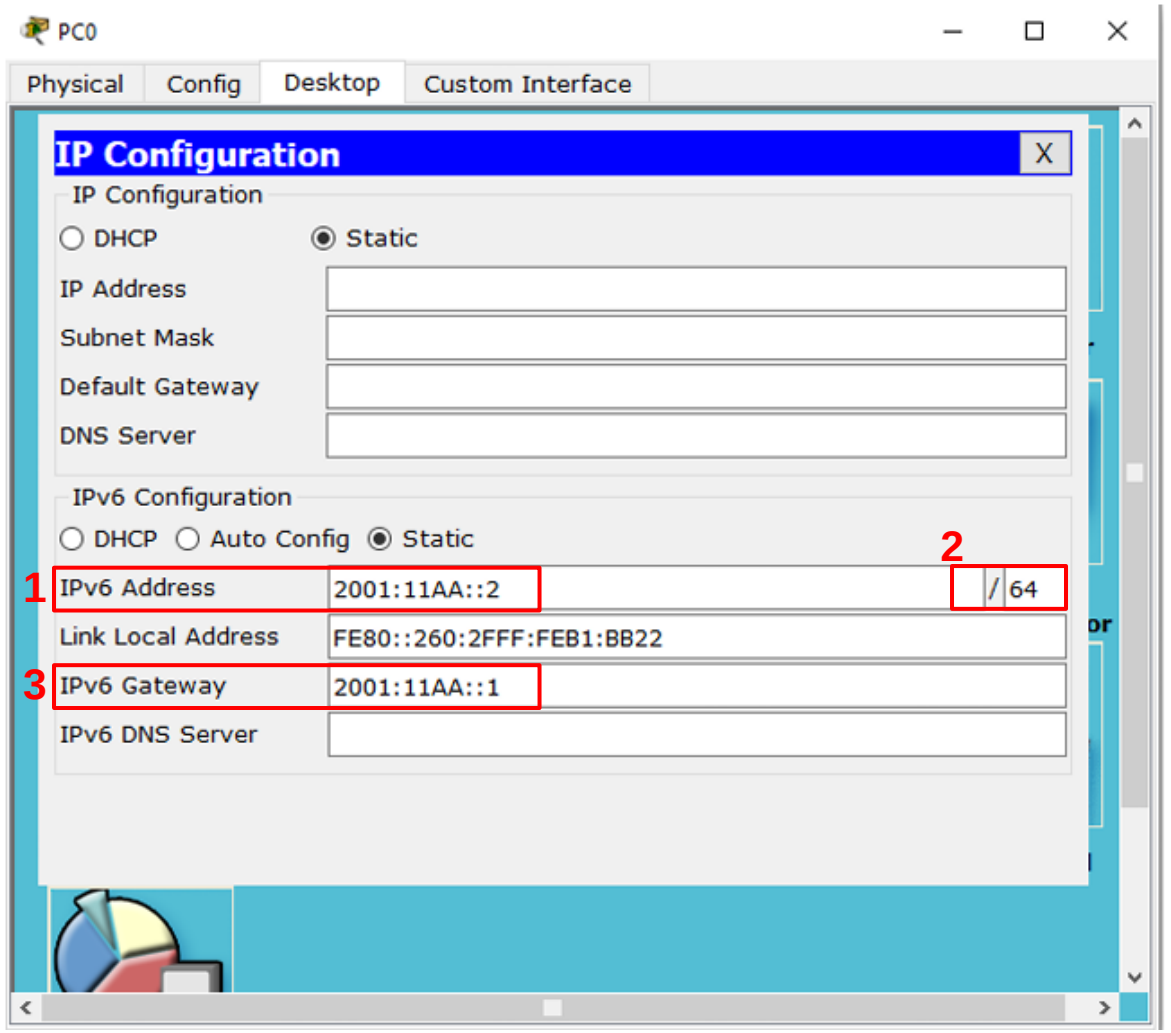
- **Use Router-2811**

- **Add an extra interface physically to Router1**





Step 2: Configuring IPv6 for the PCs



Step 3: Configuring IPv6 for the routers

- **Router0(config)# interface Fa0/1**
- **Router0(config-if)# no shutdown**
- **Router0(config-if)# ipv6 address 2001:11AA::1/64**

- **Repeat steps for all interfaces on routers 0,1 and 2 with the correct IPv6.**

Step 4: Configuring routing protocols

- **Router0(config)# ipv6 unicast-routing**
- **Repeat step for all routers 1 and 2.**

Step 5: Configuring Static routing

- **Router0(config)# ipv6 route 2001:33AA::/64 2001:22AA::2**
- **Router0(config)# ipv6 route 2001:44AA::/64 2001:22AA::2**
- **Router0(config)# ipv6 route 2001:55AA::/64 2001:22AA::2**
- **Repeat step for all routers 1 and 2.**

Step 6: Configuring RIPng routing protocol

- **Router2(config)# interface Fa0/0**
- **Router2(config-if)# ipv6 rip 1 enable**
- **Repeat steps for router 2 Fa0/1 and for router 1 interfaces Fa0/1 and Fa1/0 only.**

Monitoring and Maintaining CDP

- **Router# sh cdp neighbors**
- **Router# sh cdp neighbors detail**

- **Disabling CDP on an Interface**
  - **Router(config-if)# no cdp enable**

- **Disabling CDP**
  - **Router(config)# no cdp run**

Saving Configurations

- **Don't forget to save the configurations on your router.**

  → **Router# write**

Video explaining the experiment

--Soon--

References

- **Manual for ENCS4130 Computer Networks Laboratory.**