IPv4 to IPv6 Address Transition System with Automated Configuration

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ABSTRACT

The transition from IPv4 to IPv6 is crucial due to the depletion of IPv4 addresses. IPv6 expands the address space to accommodate the growing number of devices. This project develops a Python program using Netmiko to automate converting IPv4 addresses to IPv6 on Cisco routers. The program retrieves IPv4 addresses, converts them to IPv6, and configures the router. It also enables IPv6 routing with OSPFv3 and sets up DHCPv6 for address distribution.

The results show the program effectively speeds up the transition and reduces configuration errors, making IPv6 adoption easier and more efficient for network management.

INTRODUCTION

IPV4 Depleted

4 blocks of 8 bits each
32 bits per address a
Total of approx. 4.3 billion IPs
192.168.200.10

IPV6

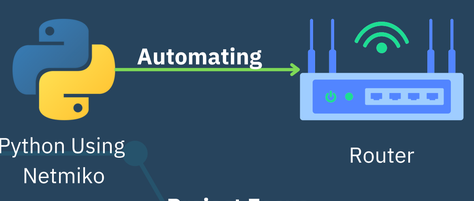
8 blocks of 16 bits each
128 bits per address
a total of approx. 340 sextillion IPs
2003:edfc:234:44ff:56:9345:0b78

Challenges in Migration

IPv4 (32-bit) addresses are running out, making network expansion difficult.
IPv6 (128-bit) solves this by offering a vastly larger address space.

Challenges in Migration

Upgrading network devices (Routers, Switches) requires careful planning. Ensuring IPv4-IPv6 interoperability is crucial to avoid disruptions.



Project Focus

Automating IPv4 to IPv6 migration using Python & Netmiko. Implementing OSPFv3 (Routing) & DHCPv6 (Address Allocation). Ensuring a secure, stable, and efficient transition to IPv6.

TECHNOLOGY

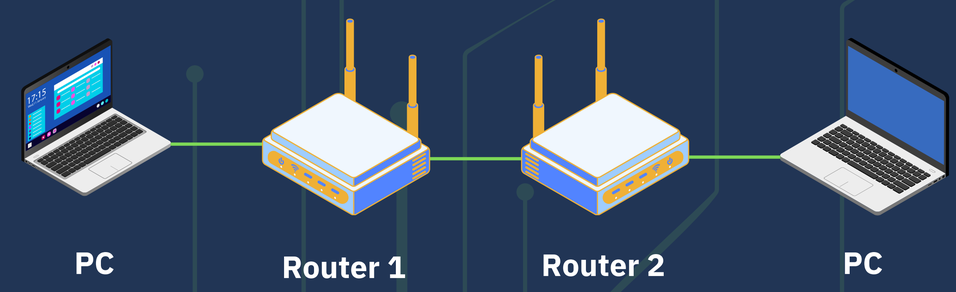
PYTHON

GNS3

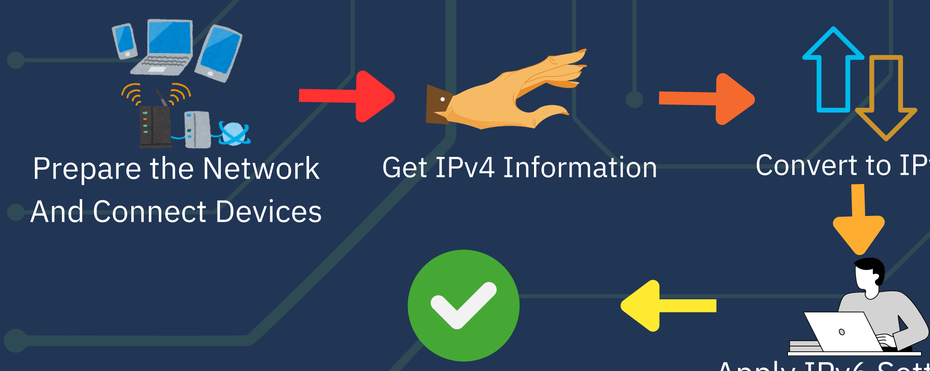
CISCO

CISCO PACKETTRACER

DESIGN



STEP



RESULT

```
--- Connecting to 10.1.1.1 ---

[+] IPv4 Addresses on 10.1.1.1:
  - FastEthernet0/0: 10.1.1.1
  - Serial0/0/0: 10.1.2.1

[+] Configuring IPv6 Addresses:
  - FastEthernet0/0: 2001:db8:0000::0A01:0101/64
  - Serial0/0/0: 2001:db8:0001::0A01:0201/64

[+] Configuring OSPFv3

[+] Configuring DHCPv6

✅ Configuration completed for 10.1.1.1

--- Connecting to 10.1.1.2 ---

[+] IPv4 Addresses on 10.1.1.2:
  - FastEthernet0/0: 192.168.1.1
  - Serial0/0/0: 10.1.2.2

[+] Configuring IPv6 Addresses:
  - FastEthernet0/0: 2001:db8:0000::C0A8:0101/64
  - Serial0/0/0: 2001:db8:0001::0A01:0202/64

[+] Configuring OSPFv3

[+] Configuring DHCPv6

✅ Configuration completed for 10.1.1.2

--- Verifying Connectivity ---
[+] Pinging 2001:db8:0001::0A01:0202 from 10.1.1.1

--- Ping Results ---
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/3 ms
[+] Pinging 2001:db8:0001::0A01:0201 from 10.1.1.2

--- Ping Results ---
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/3 ms
```

- ✅ IPv4 to IPv6 conversion: Successful
- ✅ IPv6 address configured on router interfaces: Verified with show ipv6 interface brief
- ✅ OSPFv3 routing: Enabled and verified with show ipv6 route
- ✅ ICMPv6 Connectivity Test: Passed with no packet loss
- ✅ DHCPv6 Configuration: PC received dynamic IPv6 addresses successfully
- ✅ Performance Test: Minimal latency with no significant packet loss

CONCLUSION

- This project demonstrated that automating the IPv4 to IPv6 transition is feasible using Python and Netmiko on Cisco routers.
- Automation simplified address conversion, interface configuration, OSPFv3 routing, and DHCPv6 setup, achieving full IPv6 connectivity.
- The results showed that automation reduces manual errors and accelerates IPv6 adoption.
- This approach provides a practical and efficient solution for upgrading large-scale networks to IPv6.

This solution is essential for seamless IPv6 deployment in modern network systems.

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[1]Dounia El Idrissi, Najib Elkamoun, and Rachid Hilal, “Study of the Impact of the Transition from IPv4 to IPv6 Based on the Tunneling Mechanism in Mobile Networks,” Procedia Computer Science, vol. 192, pp. 2537-2545, [online]. Available: https://www.sciencedirect.com/science/article/pii/S1877050921014216. [Accessed: 04-Sep-2024].

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