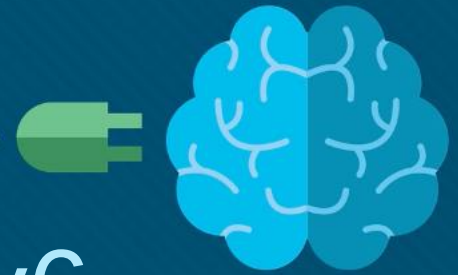


Module 10: IPv4 and IPv6 Address Management

Networking Essentials (NETESS)

Module Objectives

Module Title: IPv4 and IPv6 Address Management
Module Objective: Explain the principles of IPv4 and IPv6 address management.

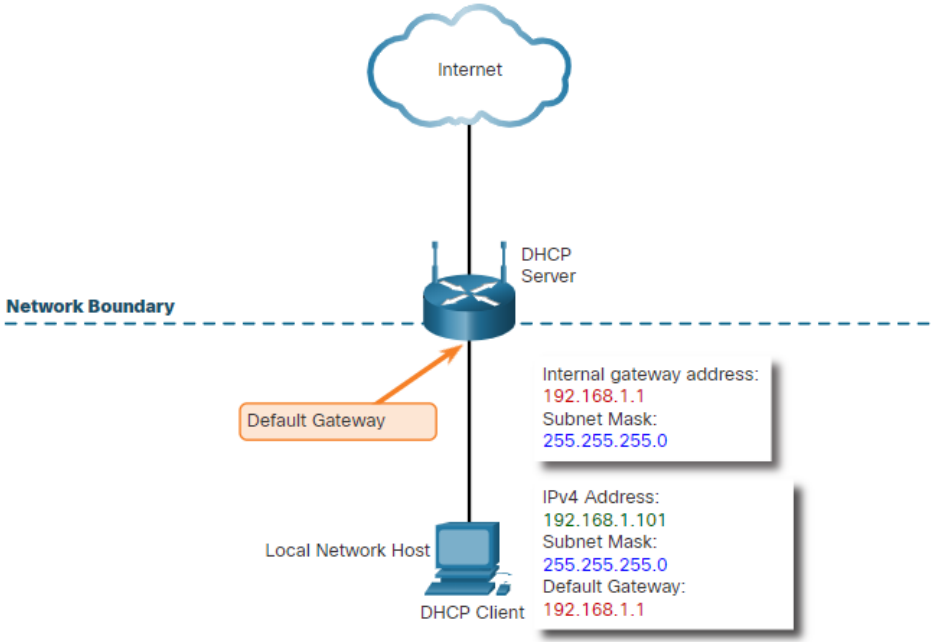
Topic Title	Topic Objective
Network Boundaries	Describe network boundaries.
Network Address Translation	Explain the purpose of Network Address Translation in small networks.
IPv4 Issues	Explain why IPv6 addressing will replace IPv4 addressing.
IPv6 Features	Explain features of IPv6.

10.1 Network Boundaries

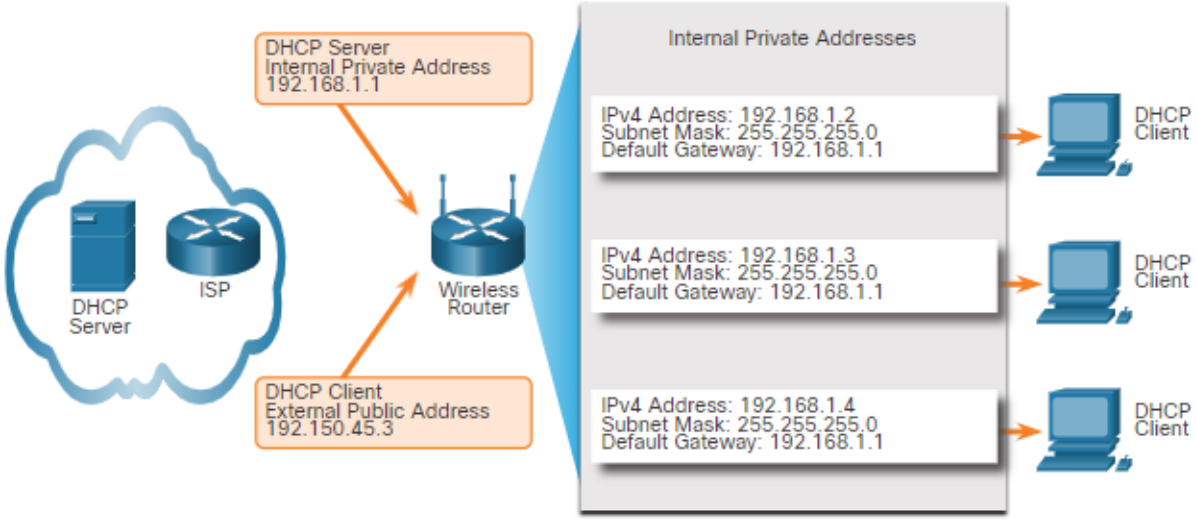
Video - Gateways to Other Networks

Routers as Gateways

- Routers are used to connect networks.
- Each router interface connects to a separate network.
- The IPv4 address assigned to the interface is the default gateway address for all hosts connected to that same network.
- Hosts commonly get an IPv4 address using DHCP.



Routers as Boundaries Between Networks



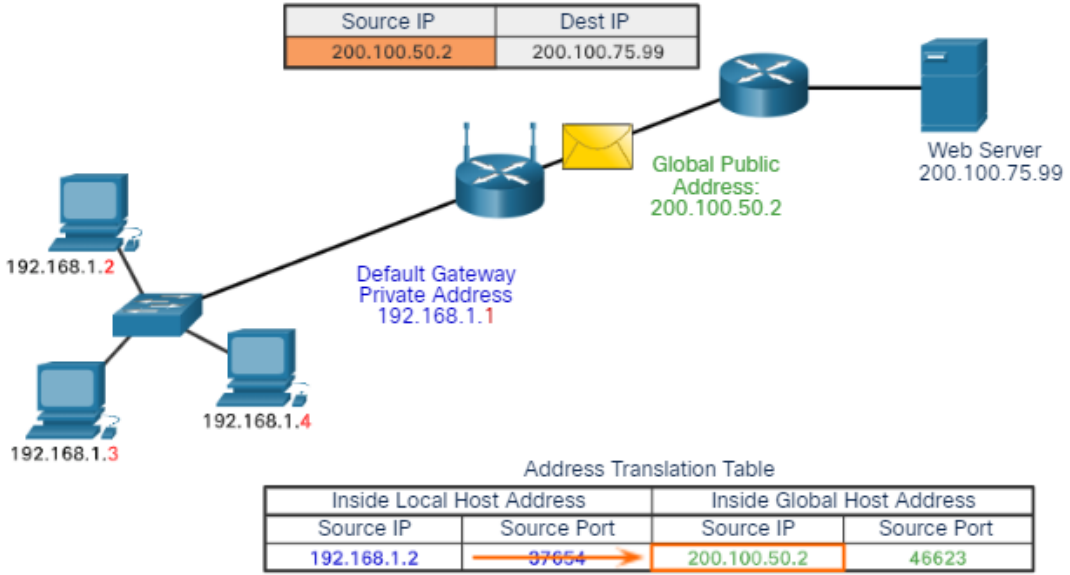
- A wireless router commonly provides IP addressing information for local internal hosts.
- A router that connects to the internet commonly gets addressing information using DHCP from the internet provider.

10.2 Network Address Translation

Video - Introduction to NAT

NAT Operation

- NAT is used to convert private IP addresses used within a company to a public (global) address that can be routed on the internet.
- One public address can be shared among many private IP addresses through the use of port numbers.



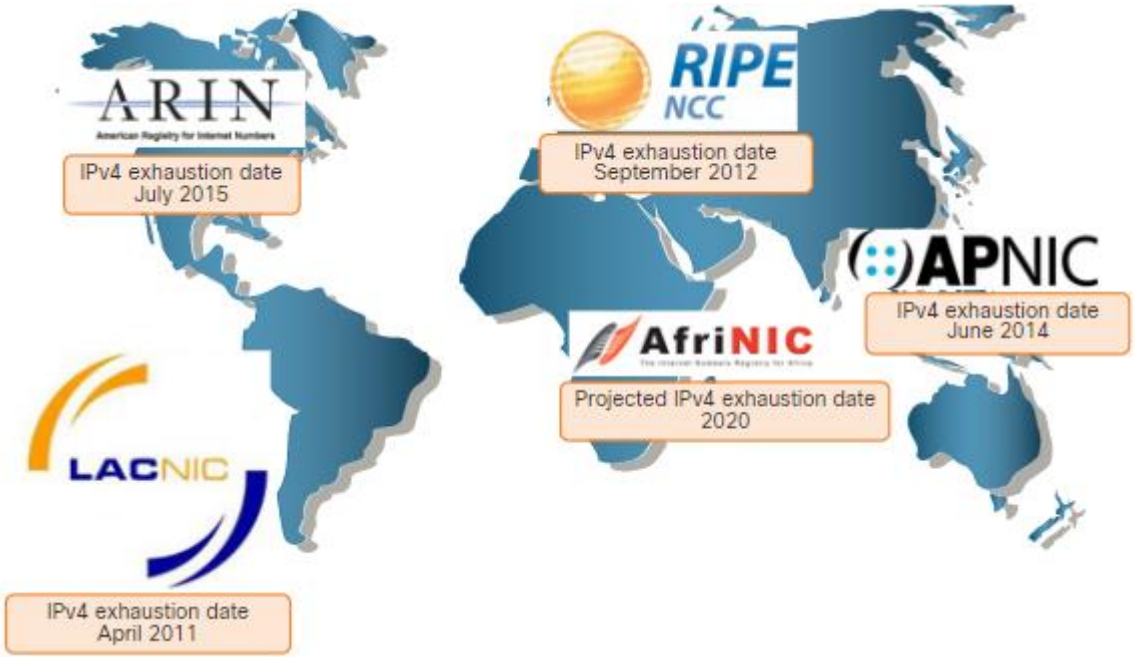
Packet Tracer – Examine NAT on a Wireless Router

In this activity, you will complete the following objectives:

- Examine NAT configuration on a wireless router.
- Set up 4 PCs to connect to a wireless router using DHCP.
- Examine traffic that crosses the network using NAT.

10.3 IPv4 Issues

Need for IPv6



- While NAT has been used to slow the depletion of IPv4 addresses, NAT creates latency and has limitations.
- IoT devices are furthering the need for IPv6 addressing.

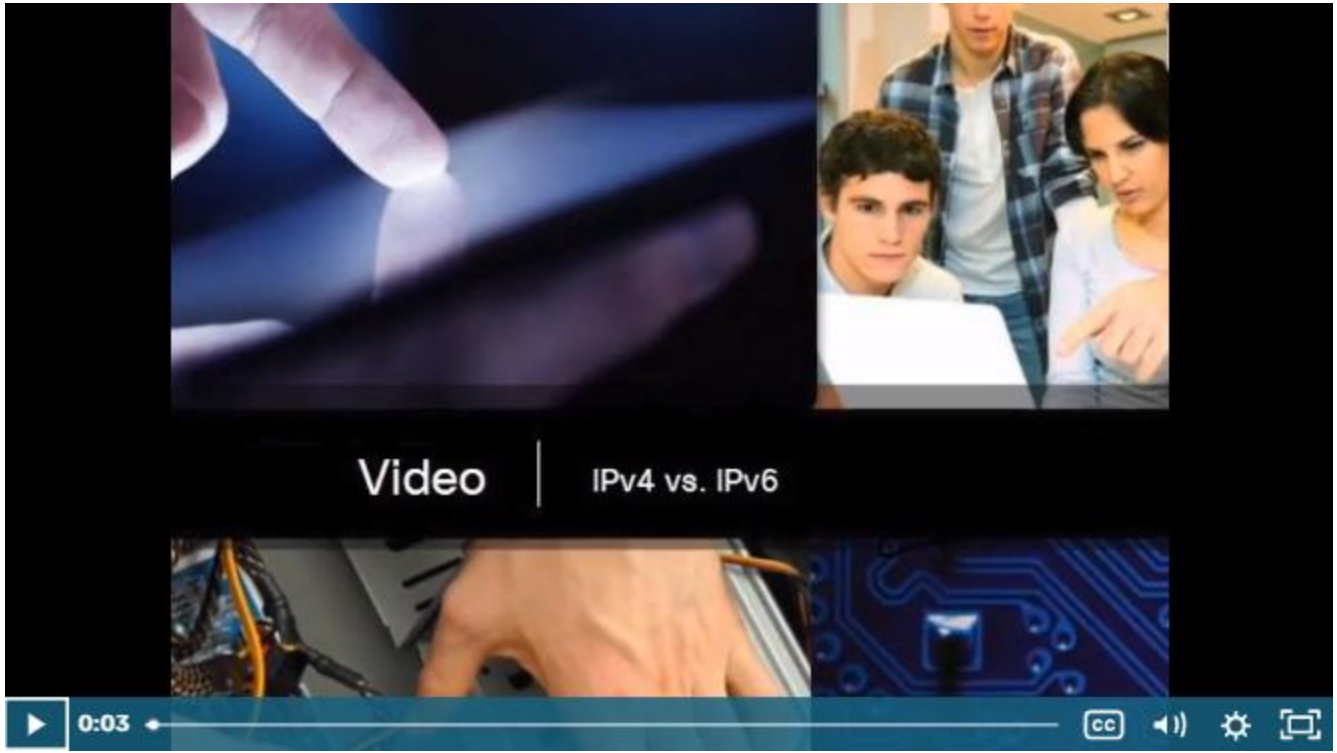
IPv6 Address Size

Number Name	Scientific Notation	Number of Zeros
1 Thousand	10^3	1,000
1 Million	10^6	1,000,000
1 Billion	10^9	1,000,000,000
1 Trillion	10^{12}	1,000,000,000,000
1 Quadrillion	10^{15}	1,000,000,000,000,000
1 Quintillion	10^{18}	1,000,000,000,000,000,000
1 Sextillion	10^{21}	1,000,000,000,000,000,000,000
1 Septillion	10^{24}	1,000,000,000,000,000,000,000,000
1 Octillion	10^{27}	1,000,000,000,000,000,000,000,000,000

IPv6 Address Size (Cont.)

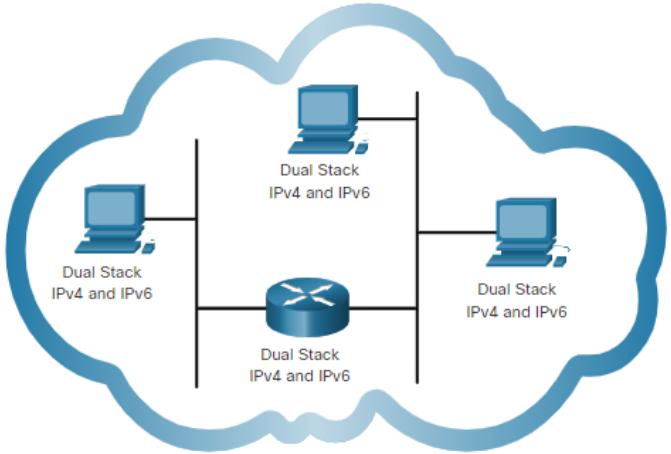
Number Name	Scientific Notation	Number of Zeros
1 Nonillion	10^{30}	1,000,000,000,000,000,000,000,000,000,000
1 Decillion	10^{33}	1,000,000,000,000,000,000,000,000,000,000,000
1 Undecillion	10^{36}	1,000,000,000,000,000,000,000,000,000,000,000,000

Video - Compare IPv4 and IPv6 Addressing



IPv4 and IPv6 Coexistence

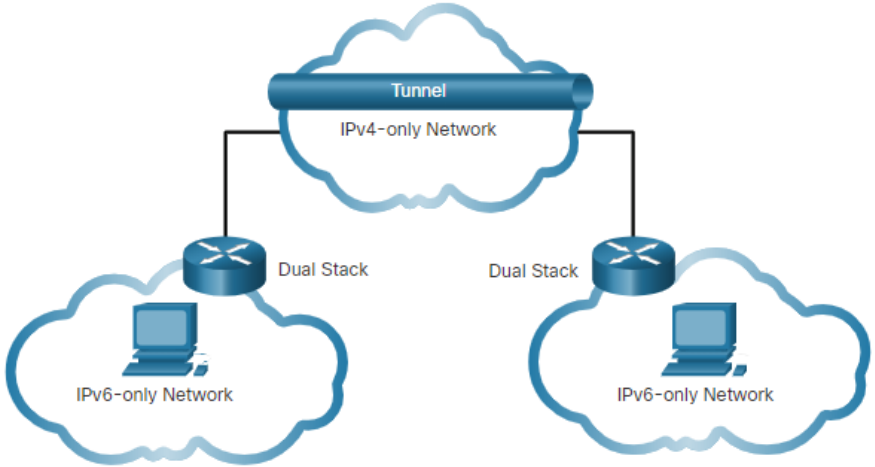
Dual stack allows IPv4 and IPv6 to coexist on the same network segment. Dual stack devices run both IPv4 and IPv6 protocol stacks simultaneously. Known as native IPv6, this means the customer network has an IPv6 connection to its ISP and is able to access content found on the internet over IPv6.



Dual Stack Routers and PCs

IPv4 and IPv6 Coexistence (Cont.)

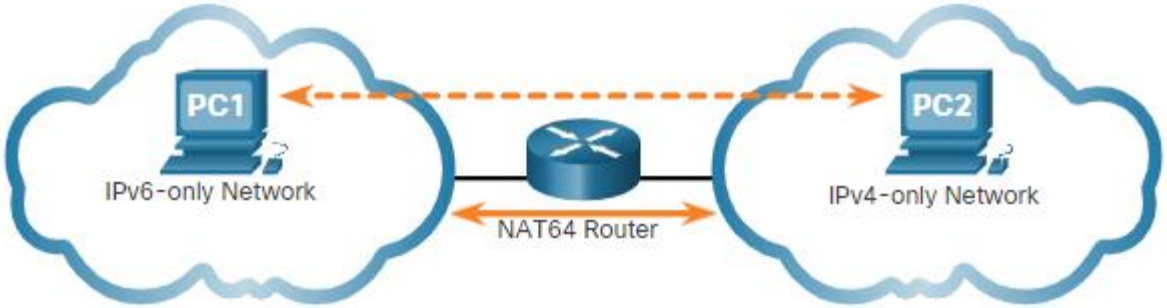
Tunneling is a method of transporting an IPv6 packet over an IPv4 network. The IPv6 packet is encapsulated inside an IPv4 packet, similar to other types of data.



IPv4 Tunnel Between Two Dual Stack Routers that connect to IPv6-only Networks

IPv4 and IPv6 Coexistence (Cont.)

Tunneling is a method of transporting an IPv6 packet over an IPv4 network. The IPv6 packet is encapsulated inside an IPv4 packet, similar to other types of data.



NAT64 Router Translating
Between an IPv6-only Network
and an IPv4-only Network

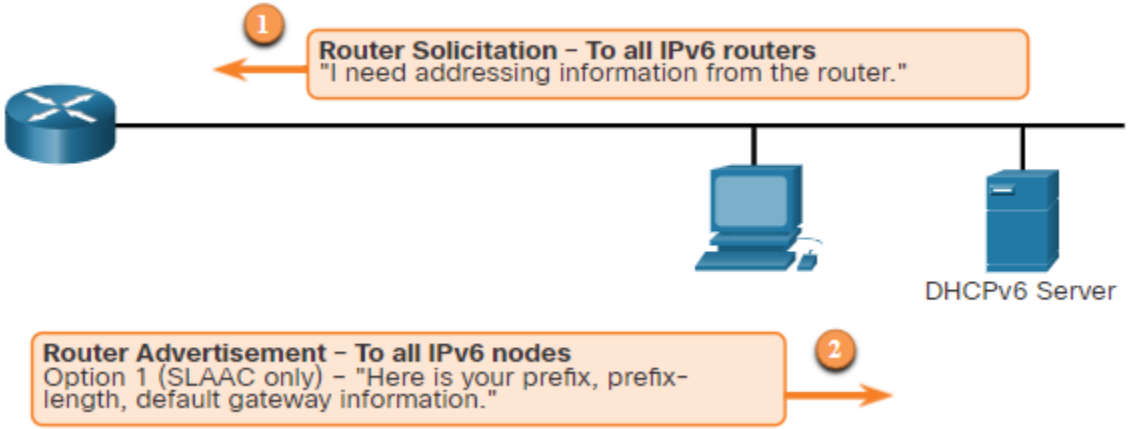
10.4 IPv6 Features

Video - The Hexadecimal Number System

Video - Differences Between IPV4 and IPv6

IPv6 Autoconfiguration and Link-Local Addresses

- Stateless Address Autoconfiguration (SLAAC) allows a host to create its own internet-routable IPv6 address without the need for a DHCP server.
- Link-local address is used to communicate with devices on the same IPv6 local network.



Video - IPv6 Address Representation

IPv6 Address Representation

- Omit leading zeros in any 16-bit section
  - ODB8 is DB8
  - 0000 is 0
  - 0200 is 200
- Omit any group of consecutive “all zero” segments and insert a double colon (::)
  - Can only use one ::

Fully expanded	2001:0DB8:0000:1111:0000:0000:0000:0200
No leading 0s	2001:DB8:0:1111:0:0:0:200
Compressed	2001:DB8:0:1111::200

Lab - Identify IPv6 Addresses

In this lab, you will complete the following objectives:

- Identify the different types of IPv6 addresses.
- Examine a host IPv6 network interface and address.
- Practice IPv6 address abbreviation.

10.5 IPv4 and IPv6 Address Management Summary

What Did I Learn in this Module?

- Routers create network boundaries.
- The IP address on a router interface that connects to an internal (inside) network is the default gateway address for all hosts on that same network.
- The IP address assigned to the internet side of a router such as a wireless router is the external, or outside, network.
- Network Address Translation (NAT) is used co convert private IP addresses used on an internal network to a public (global) address that can be routed through the internet.
- With NAT one single public address can be used for many internal hosts.
- Public IPv4 addresses have been scarce for some time.
- An IPv6 address is 128 bits and does not require NAT.
- IPv6 addresses support address autoconfiguration using SLAAC and link-local addresses.
- Two ways of shortening an IPv6 address is to omit the leading zeros and to use a double colon for any group of consecutive segments that contain all zeros.
- Dual stack allows IPv4 and IPv6 networks to coexist.
- Tunneling is a method used to transport an IPv6 packet over an IPv4 network.
- NAT64 allows IPv6-enabled devices to communicate with IPv4-enabled devices.

IPv4 and IPv6 Address Management Summary

New Terms and Commands

network boundary
network address translation (NAT)
IPv4 address exhaustion
IPv6 address
hexadecimal
dual stack
tunneling
Translation
address autoconfiguration
Stateless Address Autoconfiguration (SLAAC)
link-local address
leading zeros
all zero segment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