IP Addressing
and
Subnetting IP Networks

Introduction to Networks v6.0

Chapter 7: IP Addressing

Pertemuan ke 7

Kompetensi Khusus

- Mahasiswa dapat melakukan konfigurasi alamat IPv4 dan IPv6 untuk menyediakan konektivitas dalam jaringan internet lingkup kecil dan menengah (C3)

Materi:

1. IPv4 Network Addresses
2. IPv6 Network Addresses
3. Connectivity Verification
4. Subnetting an IPv4 Network
5. Addressing Schemes
6. Design Considerations for IPv6

1. IPv4 Network Addresses

1.1 Binary and Decimal Conversion

- IPv4 Addresses
  - consists of a string of 32 bits, divided into four sections called *octets*.
  - Each octet contains 8 bits (or 1 byte) separated with a dot.
- Conversion between Binary to Decimal
  - Use the chart to help with conversion

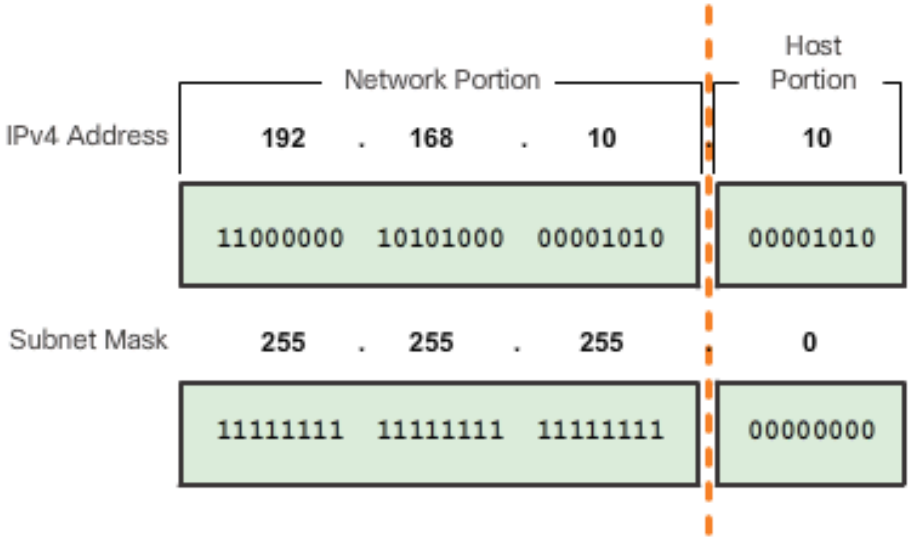
192	.	168	.	10	.	10
11000000		10101000		00001010		00001010

192.168.10.10 is an IP address that is assigned to a computer.

Positional Value	128	64	32	16	8	4	2	1
Binary number								
Calculate	x 128	x 64	x 32	x 16	x 8	x 4	x 2	x 1
Add them up ...								
Result								

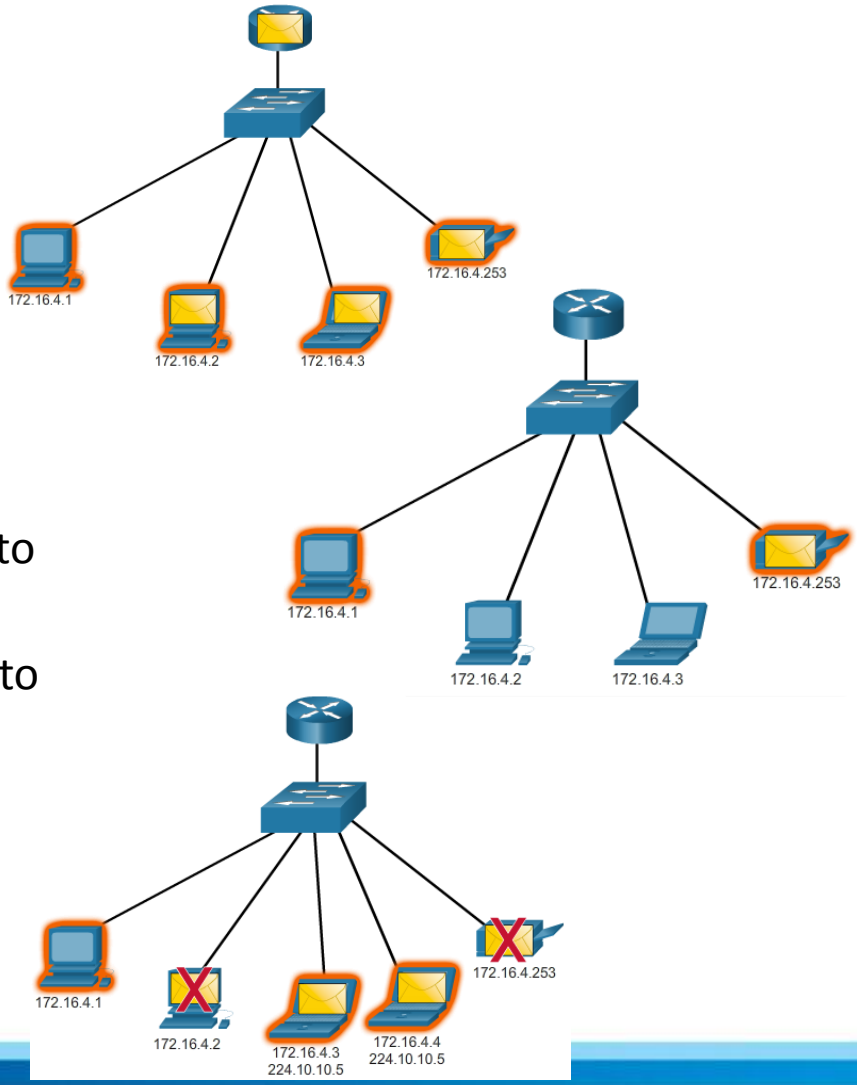
1.2 IPv4 Address Structure

- Network and Host Portions
- The Subnet Mask
- Logical AND
  - What is the network address for graphics?
- Prefix Length
  - What is the prefix length for the graphics?
- Network, Host, and Broadcast Addresses
  - Network Address?
  - Range of Valid Hosts?
  - Broadcast Address?



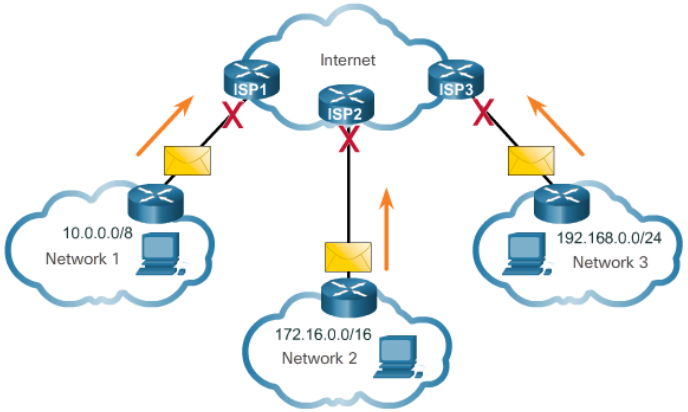
1.3 IPv4 Unicast, Broadcast, and Multicast

- IPv4 Addressing Assignment to a Host
  - Static – Type in manually
  - Dynamic - Dynamic Host Configuration Protocol (DHCP)
- IPv4 Communication
  - Unicast - send packets from one host to an individual host
  - Broadcast - send packets from one host to all the hosts in the network
  - Multicast - send a packet from one host to a selected group of hosts in the same or different network
  - Which types of communication are the graphics on the right?



1.4 Types of IPv4 Addresses

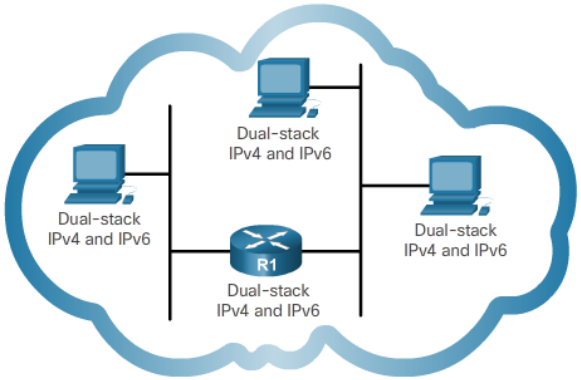
- Public and Private IPv4 Addresses
  - Private addresses are not routed over the Internet
  - Private Addresses:
    - 10.0.0.0/8 or 10.0.0.0 to10.255.255.255
    - 172.16.0.0 /12 or 172.16.0.0 to 172.31.255.255
    - 192.168.0.0 /16 or 192.168.0.0 to 192.168.255.255
- Special User IPv4 Addresses
  - Loopback addresses
    - 127.0.0.0 /8 or 127.0.0.1 to 127.255.255.254
  - Link-Local addresses or Automatic Private IP Addressing (APIPA) addresses
    - 169.254.0.0 /16 or 169.254.0.1 to 169.254.255.254
  - TEST-NET addresses
    - 192.0.2.0/24 or 192.0.2.0 to 192.0.2.255
- Classless Addressing
  - CIDR
  - Allocated IPv4 addresses based on prefix length
- Assignment of IP Addresses

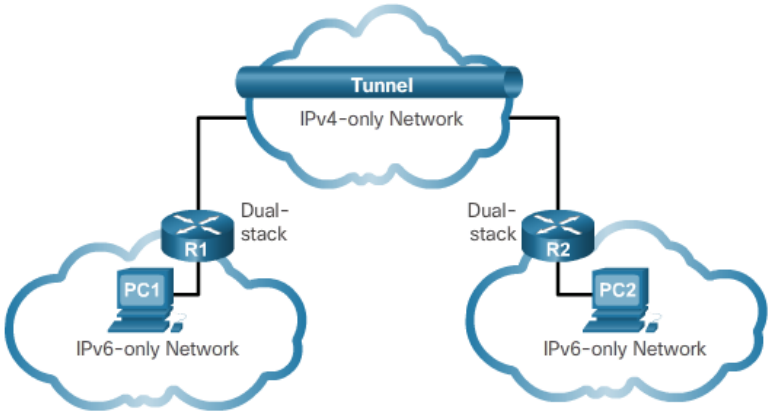


2. IPv6 Network Addresses

2.1 IPv4 Issues

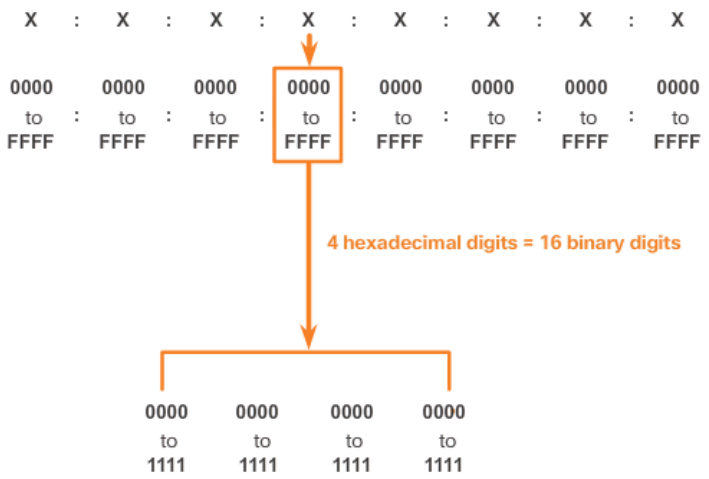
- The Need for IPv6
  - Depletion of IPv4 address space
  - Internet of Everything
- IPv4 and IPv6 Coexistence
  - Dual Stack – IPv4 and IPv6 on the same network
  - Tunneling – IPv6 packets inside IPv4 packets
  - Translation - IPv6 packet is translated to an IPv4 packet, and vice versa.





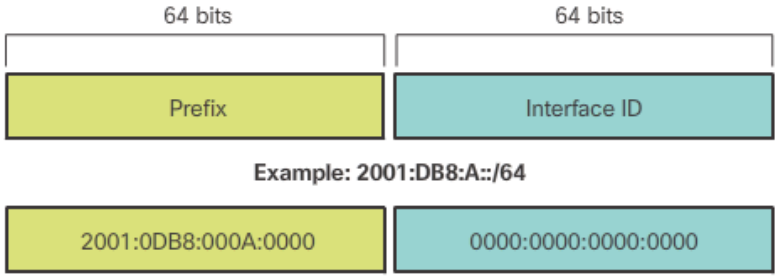
2.2 IPv6 Addressing

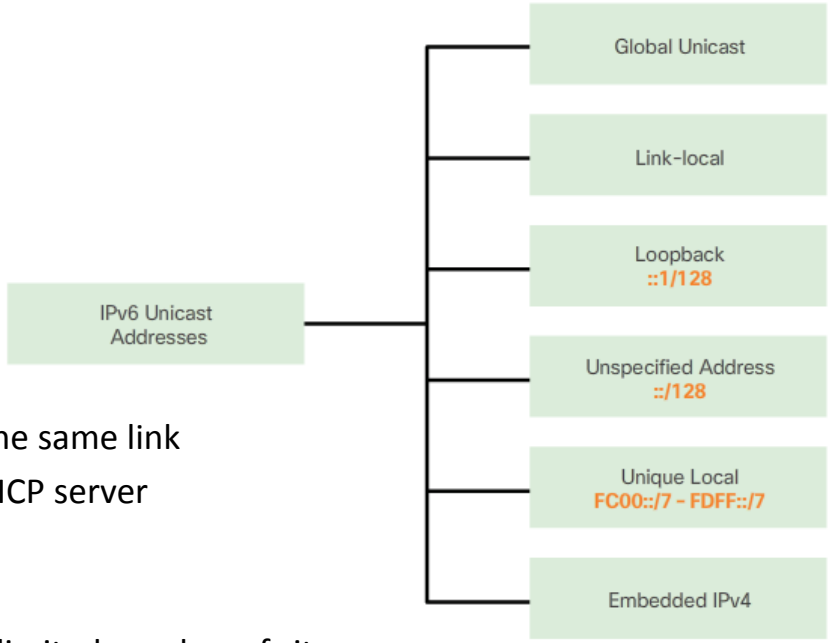
- IPv6 Address Representation
  - x:x:x:x:x:x:x:x, where x represents 4 hexadecimal values
- Apply the rules to simply these IPv6 Addresses
  - Rule 1: Omit Leading 0s
  - Rule 2: Omit All 0 Segments
    - 2001:0DB8:0000:1133:0000:0000:0000:0200
    - 2001:0DB8:CAFE:0000:1111:0000:0000:0200
    - 2001:0DB8:000A:0000:0000:0000:0000:1000
    - 2001:0DB8:ACAD:1234:0000:0000:0000:0000
    - 2001:0DB8:0000:1111:0020:0000:ACAD:0000
    - FF02:0000:0000:0000:0000:0000:0000:0001
    - FE80:0000:0000:0000:0000:0000:0000:0003
    - 0000:0000:0000:0000:0000:0000:0000:0000



2.3 Types of IPv6 Addresses

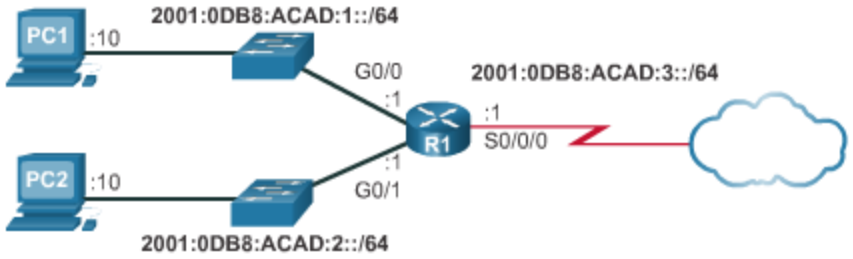
- IPv6 Address Types
  - Unicast
  - Multicast
  - Anycast
- IPv6 Prefix Length
  - Indicates the network portion
  - Format: IPv6 address /prefix length
  - Prefix length range from 0 to 128
  - Typical length is /64
- Common Types of IPv6 Addresses
  - Unicast Addresses
    - Unique, Internet routable addresses
    - Configured statically or assigned dynamically
  - Link-Local Unicast Addresses
    - Communicate with other IPv6 enabled devices on the same link
    - Device creates its own link local address without DHCP server
  - Unique Local Addresses
    - Unique local unicast
    - Used for local addresses within a site or between a limited number of sites



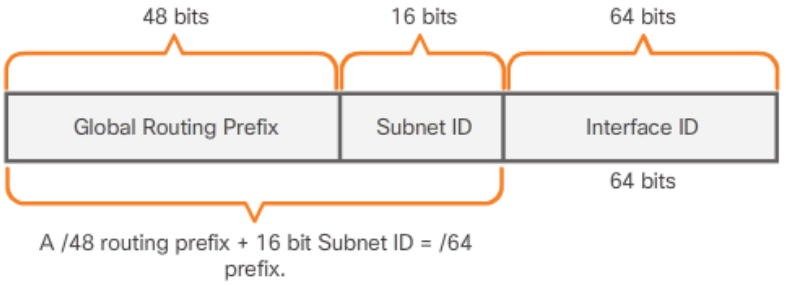


2.4 IPv6 Unicast Addresses

- Structure of an IPv6 Global Unicast Address
  - Global Routing Prefix
  - Subnet ID
  - Interface ID
- Static Configuration of a Global Unicast Address
  - **ipv6 address** *ipv6-address/prefix-length*
- Dynamic Configuration
  - SLAAC
  - DHCPv6
- Link-Local Addresses
  - Dynamic or Static
- Verifying IPv6 Address Configuration
  - show ipv6 interface brief

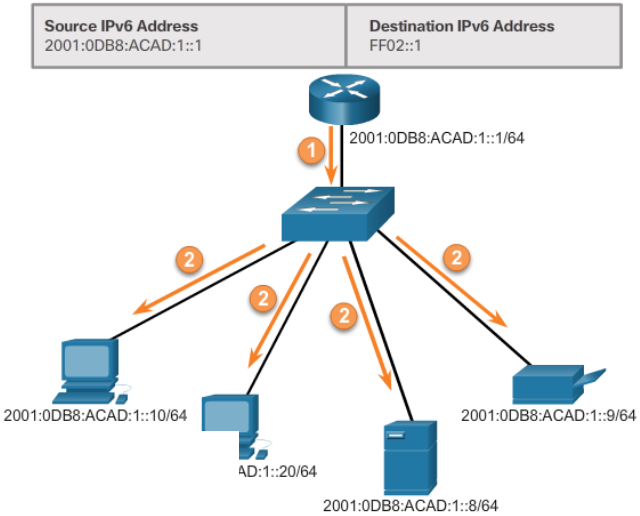


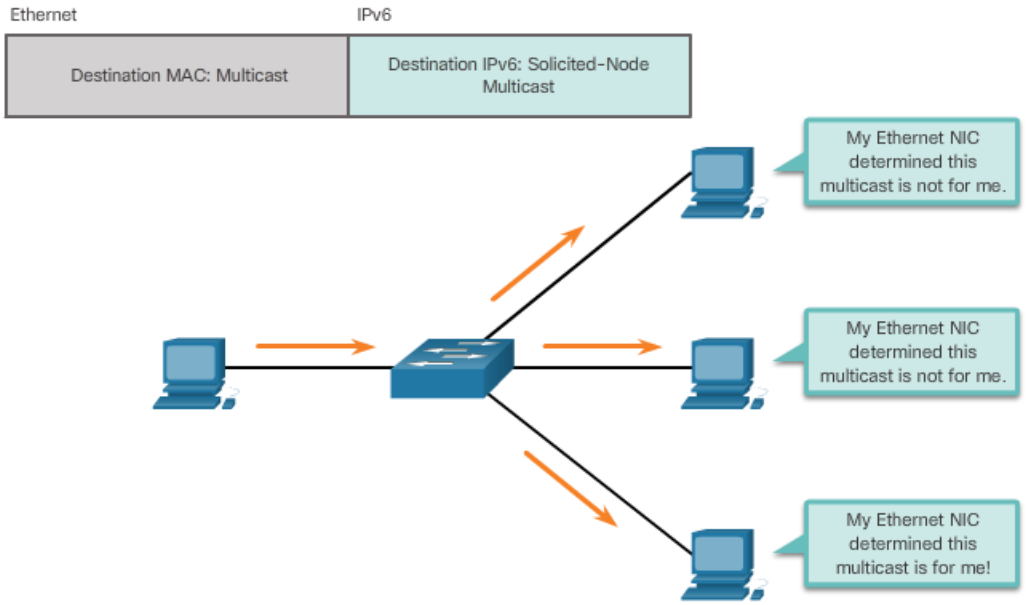

```
R1(config)#interface gigabitethernet 0/0
R1(config-if)#ipv6 address 2001:db8:acad:1::1/64
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#interface gigabitethernet 0/1
R1(config-if)#ipv6 address 2001:db8:acad:2::1/64
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#interface serial 0/0/0
R1(config-if)#ipv6 address 2001:db8:acad:3::1/64
R1(config-if)#clock rate 56000
R1(config-if)#no shutdown
```



2.5 IPv6 Multicast Addresses

- Assigned IPv6 Multicast Addresses
  - IPv6 multicast addresses have the prefix FF00::/8
    - FF02::1 All-nodes multicast group
    - FF02::2 All-routers multicast group
- Solicited-Node IPv6 Multicast Addresses

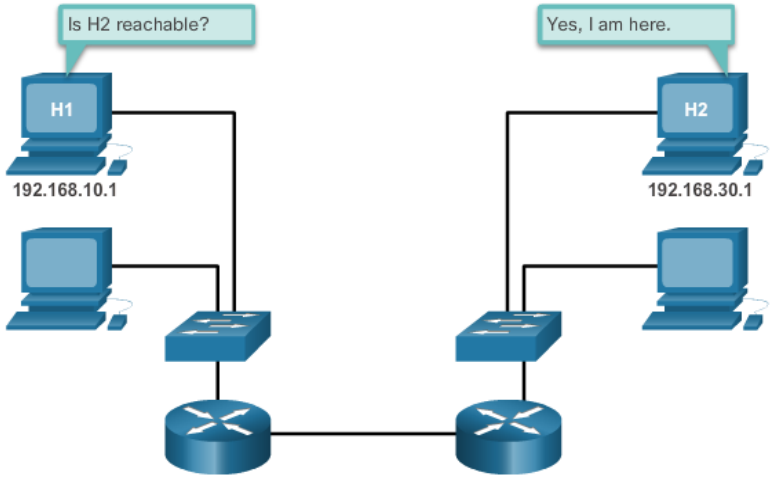




3. Connectivity Verification

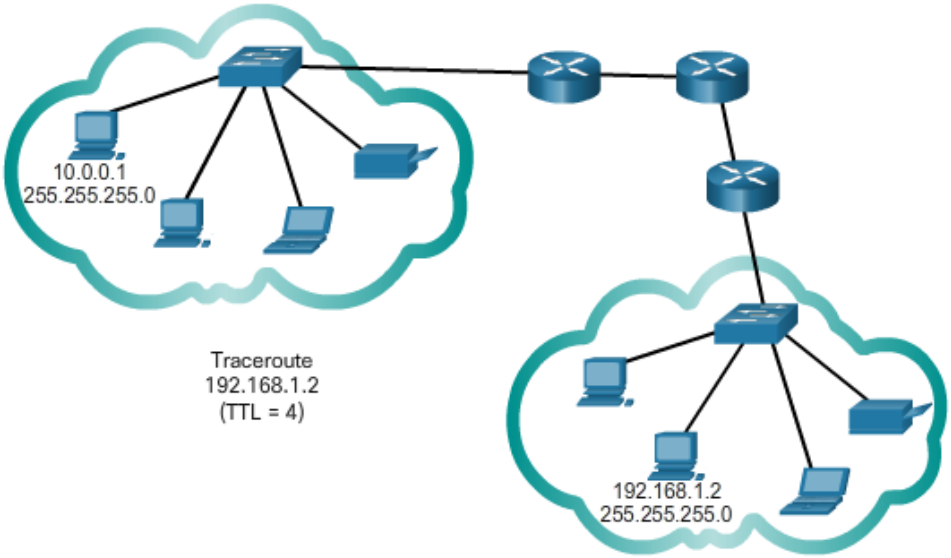
3.1 ICMP

- ICMPv4 and ICMPv6
  - Host Confirmation
  - Destination or Service Unreachable
  - Time Exceeded
  - Router Redirection
- ICMPv6 Router Solicitation and Router Advertisement Messages
  - Messaging between an IPv6 router and an IPv6 device:
    - Router Solicitation (RS) message
    - Router Advertisement (RA) message
  - Messaging between IPv6 devices:
    - Neighbor Solicitation (NS) message
    - Neighbor Advertisement (NA) message
  - Duplicate Address Detection (DAD)



3.2 Testing and Verification

- Ping
  - Testing the Local Stack
    - 127.0.0.1 (IPv4) or ::1 (IPv6)
  - Testing Connectivity to the Local LAN
  - Testing Connectivity to Remote
- Traceroute
  - Testing the Path
    - Round Trip Time (RTT)
    - IPv4 TTL and IPv6 Hop Limit



Chapter Summary

Summary

- Explain the use of IPv4 addresses to provide connectivity in a small to medium-sized business network.
- Configure IPv6 addresses to provide connectivity in small to medium-sized business networks.
- Use common testing utilities to verify network connectivity.

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