CompTIA Network+ Exam N10-008

Lesson 6

Supporting IPv4 and IPv6 Networks

Objectives

- Use appropriate tools to test IP configuration
- Troubleshoot IP networks
- Explain IPv6 addressing schemes

Lesson 6

Topic 6A

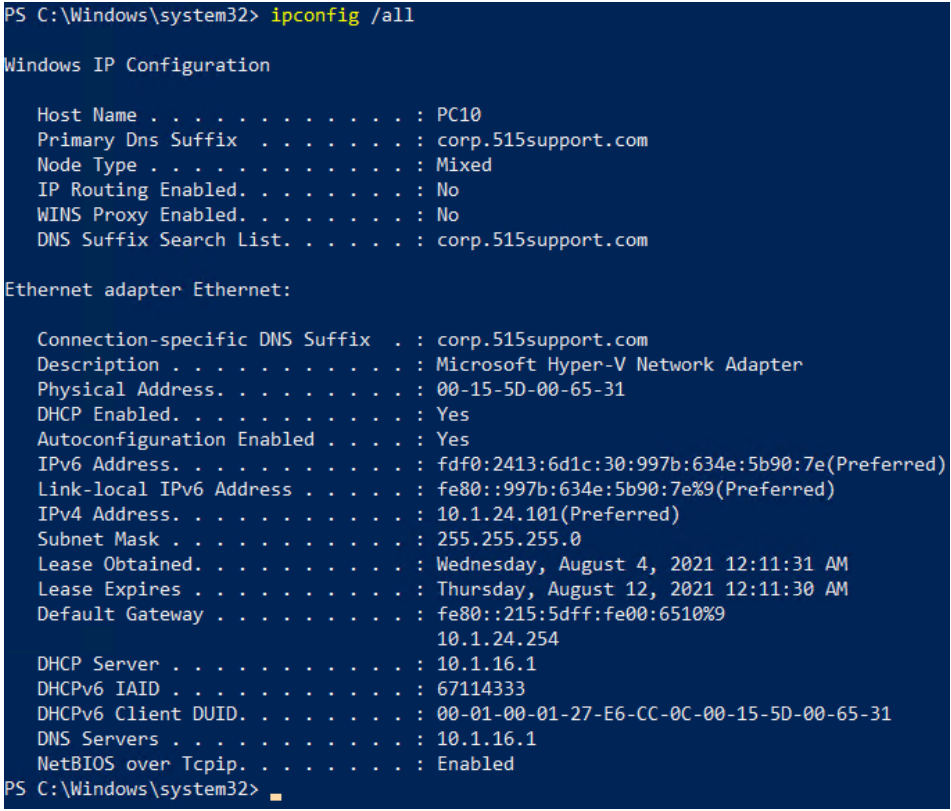
Use Appropriate Tools to Test IP Configuration

IP Interface Configuration

- Configuration parameters
  - IP address and subnet mask
  - Default gateway
  - Domain Name System (DNS) servers
- Manual configuration/static addressing versus autoconfiguration by Dynamic Host Configuration Protocol (DHCP)
- Windows networking
  - Adapter naming (Local Area Connection versus Ethernet)
  - netsh commands
  - PowerShell cmdlets

ipconfig

- Report network configuration on Windows
  - /all
  - /renew
  - /release
  - /displaydns, /flushdns, /registerdns



ifconfig and ip

```
lamp@lamp:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.16.0.201  netmask 255.255.255.0  broadcast 172.16.0.255
        inet6 fe80::215:5dff:fe00:6517  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:00:65:17  txqueuelen 1000  (Ethernet)
        RX packets 4042  bytes 589111 (589.1 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 7788  bytes 2885069 (2.8 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 5244  bytes 413133 (413.1 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 5244  bytes 413133 (413.1 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

```
lamp@lamp:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default qlen 1000
    link/ether 00:15:5d:00:65:17 brd ff:ff:ff:ff:ff:ff
    inet 172.16.0.201/24 brd 172.16.0.255 scope global dynamic eth0
       valid_lft 6026sec preferred_lft 6026sec
    inet6 fe80::215:5dff:fe00:6517/64 scope link
       valid_lft forever preferred_lft forever
```

- Linux networking
  - eth0, eth1 or en0, en1
- /etc/network/interfaces
  - ifup and ifdown
- NetworkManager and systemd.networking
- Netplan
- ifconfig (net-tools)
- ip (iproute2)

ARP Cache Utility

- Cache IP:MAC mapping to reduce ARP broadcasts
- arp utility manages cache
  - ip neigh

```
PS C:\Windows\system32> arp -a

Interface: 10.1.24.101 --- 0x9
  Internet Address      Physical Address      Type
  10.1.24.254           00-15-5d-00-65-10     dynamic
  10.1.24.255           ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

Internet Control Message Protocol and ping

```
PS C:\Windows\system32> ping 127.0.0.1 -n 1

Pinging 127.0.0.1 with 32 bytes of data:
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Ping statistics for 127.0.0.1:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
PS C:\Windows\system32> ping 10.1.24.101 -n 1

Pinging 10.1.24.101 with 32 bytes of data:
Reply from 10.1.24.101: bytes=32 time<1ms TTL=128

Ping statistics for 10.1.24.101:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
PS C:\Windows\system32> ping 10.1.24.254 -n 1

Pinging 10.1.24.254 with 32 bytes of data:
Reply from 10.1.24.254: bytes=32 time<1ms TTL=64

Ping statistics for 10.1.24.254:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
PS C:\Windows\system32> ping 203.0.113.33 -n 1

Pinging 203.0.113.33 with 32 bytes of data:
Reply from 203.0.113.33: bytes=32 time=2ms TTL=60

Ping statistics for 203.0.113.33:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 2ms, Average = 2ms
```

- Report errors and transmit status messaging
- Request and reply packets
  - Round Trip Time (RTT)
  - Time to Live (TTL)
- Destination host unreachable
- No reply (Request timed out)
- Other switches

Review Activity: Test IP Configuration

- IP Interface Configuration
- ipconfig
- ifconfig and ip
- ARP Cache Utility
- Internet Control Message Protocol and ping

Lab Activity

Assisted Lab: Use Tools to Test IP Configuration

- Lab types
  - Assisted labs guide you step-by-step through tasks
  - Applied labs set goals with limited guidance
- Complete lab
  - Submit all items for grading and check each progress box
  - Select “Grade Lab” from final page
- Save lab
  - Select the hamburger menu and select “Save”
  - Save up to two labs in progress for up to 7 days
- Cancel lab without grading
  - Select the hamburger menu and select “End”

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Topic 6B

Troubleshoot IP Networks

Hardware Failure and Network Interface Issues

- Isolate issues to OSI model layer
- Establish scope to identify hardware issues with appliances (switches and routers)
- Power issues
  - Surge/spike, brownout, and power failure/blackout
- Hardware failure issues
  - Check for cable faults
  - Verify adapter driver
  - Check module/adapter card seating and try rebooting
- Interface status issues

IP Configuration Issues

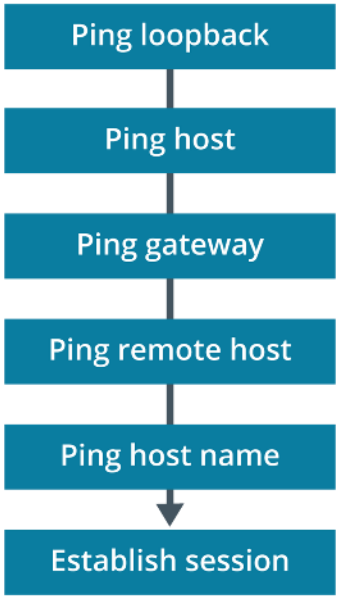
- Verify host configuration with ipconfig/ifconfig/ip
- Incorrect IP address
  - Check configuration is consistent with neighbors
- Incorrect subnet mask
  - Host routes traffic that should be delivered locally

Duplicate IP and MAC Address Issues

- Duplicate IP addresses
  - Identify MAC addresses used via ARP cache or packet trace
- Duplicate MAC address
  - ARP spoofing attack?
  - Identify host MAC addresses by using ARP cache or the switch’s MAC address table

Problem Isolation

- ping
  - Loopback
  - Discover neighbors (check ARP cache)
  - Remote host
- Incorrect gateway
  - Check IP of default gateway
  - Check link to default gateway



Incorrect DNS Issues

- Check client’s DNS server address configuration
- Check server availability

Multicast Flooding Issues

- Multicast groups and Internet Group Management Protocol (IGMP)
- Non-multicast-aware switches flood packets
- IGMP snooping

Review Activity: Troubleshoot IP Networks

- Hardware Failure and Network Interface Issues
- IP Configuration Issues
- Duplicate IP and MAC Address Issues
- Problem Isolation
- Incorrect DNS Issues
- Multicast Flooding Issues

Lesson 6

Topic 6C

Explain IPv6 Addressing Schemes

IPv4 versus IPv6

- IPv4 address shortage
  - 32-bit address space
  - Inefficiently allocated
  - Complex routing tables
- IPv6/IPng
  - 128-bit address space
  - Cope with mobile/Internet of Things (IoT) growth
  - Hierarchical address allocation (simpler routing)
- Very slow transition!

- IPv6 headers
  - Main header and extension headers
  - Key fields
    - Traffic class
    - Flow label
    - Payload length
    - Next header
    - Hop limit

IPv6 Address Format

- 128-bit binary address = lots of typing!

  0010 0000 0000 0001 : 0000 1101 1011 1000 : 0000 0000 0000 0000 :
  0000 0000 0000 0000 : 0000 1010 1011 1100 : 0000 0000 0000 0000 :
  1101 1110 1111 0000 : 0001 0010 0011 0100

- Hex notation
  - Each hex digit represents 4 binary digits
  - Arrange hex digits in 8 x 16-bit (double byte) blocks separated by colons

  2001:0db8:0000:0000:0abc:0000:def0:1234

- Canonical notation
  - Omit leading 0s and compress one sequence of all-0 double bytes

  2001:db8::abc:0:def0:1234

IPv6 Network Prefixes

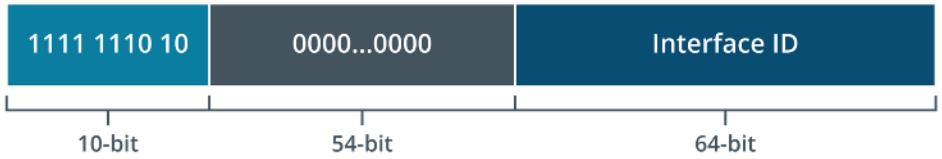
- Host ID is always last 64 bits
- Network prefix (e.g., /48 or /64) determines whether hosts are on same network
- Addressing schemes are different than IPv4
  - Multicast must be supported
  - No broadcasts

IPv6 Unicast Addressing

- Globally scoped
  - 001 binary prefix (2 or 3 in hex)
  - Next 45 bits allocated to registries and ISPs
  - Following 16 bits for subnetting
  - 64 bits for interface ID
- Interface ID/EUI-64
  - MAC-derived/EUI-64
  - Pseudo-random token

IPv6 Link Local Addressing

- fe80/10
- Not routable
- Communicate with same subnet (neighbors)
- All interfaces have link-local addresses
- Zone indices



IPv6 Interface Autoconfiguration

- Neighbor Discovery (ND) protocol and router advertisement (RA)
  - Replace ARP to perform address autoconfiguration, prefix discovery, local address resolution, and redirection
- Stateless address autoconfiguration (SLAAC)
  - Generate a unique link-local address
  - Listen for RAs
- Multicast Listener Discovery (NLD) Protocol
  - Allow nodes to join a multicast group
  - Discover whether group members are present on the local subnet
- ICMPv6

IPv6 Multicast Addressing

- IPv6 routers must support multicast
- 8-bit multicast scope (11111111 or ff in hex)
  - 4-bit flag
  - 4-bit scope (link-local/global)
  - 112-bit group ID
- Link-local multicast replaces broadcast

IPv4 and IPv6 Transition Mechanisms

- Dual stack
  - IPv6 or IPv4 default
- Tunneling
  - Encapsulate IPv6 packets in IPv4 packets
  - 6to4/6RD (IPv6 Rapid Deployment)
  - Teredo (Windows) and Miredo (Linux)
  - Generic Routing Encapsulation (GRE)

```
PS C:\Windows\system32> ipconfig /all

Windows IP Configuration

   Host Name . . . . . . . . . . . . : PC10
   Primary Dns Suffix  . . . . . . . : corp.515support.com
   Node Type . . . . . . . . . . . . : Mixed
   IP Routing Enabled. . . . . . . . : No
   WINS Proxy Enabled. . . . . . . . : No
   DNS Suffix Search List. . . . . . : corp.515support.com

Ethernet adapter Ethernet:

   Connection-specific DNS Suffix  . : corp.515support.com
   Description . . . . . . . . . . . : Microsoft Hyper-V Network Adapter
   Physical Address. . . . . . . . . : 00-15-5D-00-65-31
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv6 Address. . . . . . . . . . . : fdf0:2413:6d1c:30:997b:634e:5b90:7e(Preferred)
   Link-local IPv6 Address . . . . . : fe80::997b:634e:5b90:7e%9(Preferred)
   IPv4 Address. . . . . . . . . . . : 10.1.24.101(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Wednesday, August 4, 2021 12:11:31 AM
   Lease Expires . . . . . . . . . . : Thursday, August 12, 2021 12:11:30 AM
   Default Gateway . . . . . . . . . : fe80::215:5dff:fe00:6510%9
                                       10.1.24.254
   DHCP Server . . . . . . . . . . . : 10.1.16.1
   DHCPv6 IAID . . . . . . . . . . . : 67114333
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-27-E6-CC-0C-00-15-5D-00-65-31
   DNS Servers . . . . . . . . . . . : 10.1.16.1
   NetBIOS over Tcpip. . . . . . . . : Enabled
PS C:\Windows\system32>
```

Common IPv6 Address Prefixes

Type	Prefix	Leading Hex Characters
Global unicast	2000::/3	2 3
Link local unicast	fe80::/10	fe80
Multicast	ff00::/8	ff
Multicast (link local)	ff02::/16	ff02::1 (all nodes) ff02::2 (all routers) ff02::1:2 (DHCP)
Solicited-node	ff02::1:ff00:0/104	ff02::1:ff
Unspecified	::/128	0::0
Loopback	::1/128	::1
Documentation/Examples	2001:db8::/32	2001:db8

Review Activity: IPv6 Addressing Schemes

- IPv4 versus IPv6
- IPv6 Address Format
- IPv6 Network Prefixes
- IPv6 Unicast Addressing
- IPv6 Link Local Addressing
- IPv6 Interface Autoconfiguration
- IPv6 Multicast Addressing
- IPv4 and IPv6 Transition Mechanisms
- Common IPv6 Address Prefixes

Lab Activity

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Summary