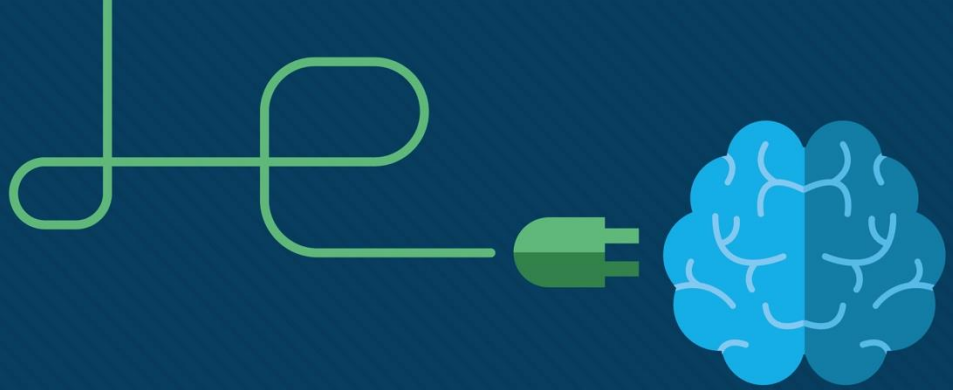


Module 17: Küçük bir Ağ Kurulumu (Build a Small Network)

CCNA1

Introduction to Networks v7.0 (ITN)

Gökhan AKIN - CCIE
gokhan@agyoneticileri.org

Ozan BÜK - CCIE
ozan@agyoneticileri.org

17.1 Devices in a Small Network

Small Network Topologies

- The majority of businesses are small most of **the business networks** are also small.
- A small network design is **usually simple**.
- Small networks typically have a **single WAN connection provided by DSL**, cable, or an Ethernet connection.
- Large networks require an IT department to maintain, secure, and troubleshoot network devices and to protect organizational data. Small networks are managed by a local IT technician or by a contracted professional.

Device Selection for a Small Network

Like large networks, small networks require planning and design to meet user requirements. Planning ensures that all requirements, cost factors, and deployment options are given due consideration. One of the first design considerations is the type of intermediary devices to use to support the network.

Factors that must be considered when selecting network devices include:

- cost
- speed and types of ports/interfaces
- expandability
- operating system features and services

IP Addressing for a Small Network

When implementing a network, create an IP addressing scheme and use it. All hosts and devices within an internetwork must have a unique address. Devices that will factor into the IP addressing scheme include the following:

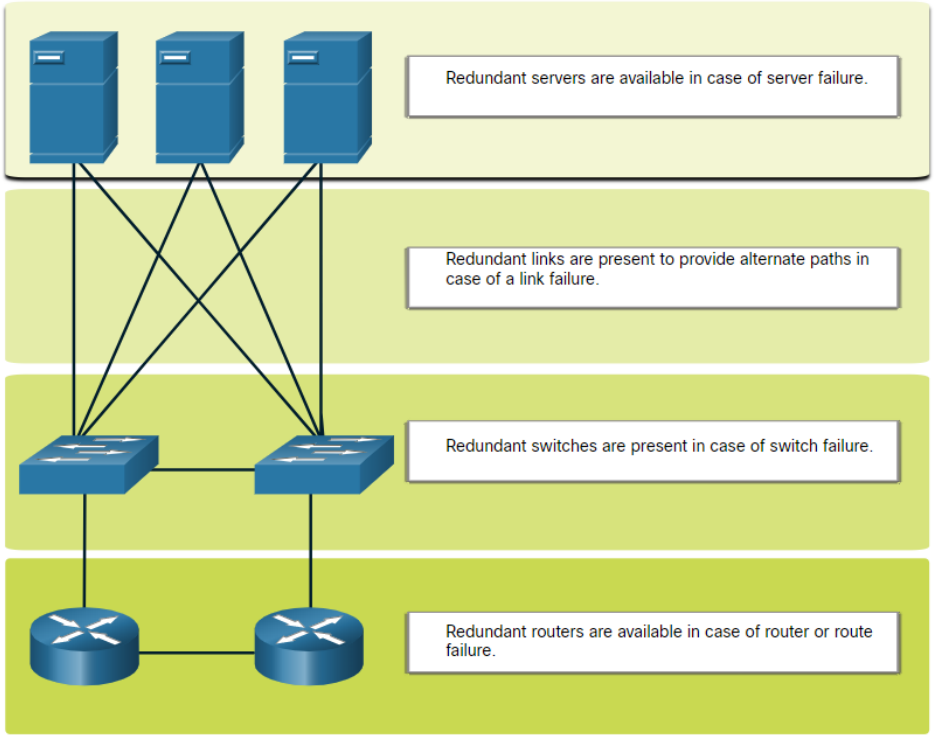
- End user devices - The number and type of connections (i.e., wired, wireless, remote access)
- Servers and peripherals devices (e.g., printers and security cameras)
- Intermediary devices including switches and access points

It is recommended that you plan, document, and maintain an IP addressing scheme based on device type. The use of a planned IP addressing scheme makes it easier to identify a type of device and to troubleshoot problems.

Redundancy in a Small Network

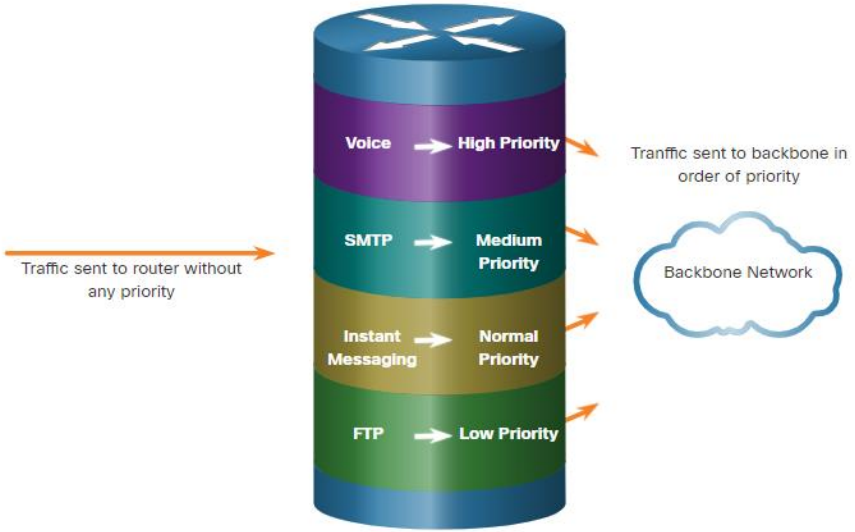
In order to maintain a high degree of reliability, *redundancy* is required in the network design. Redundancy helps to eliminate single points of failure.

Redundancy can be accomplished by installing duplicate equipment. It can also be accomplished by supplying duplicate network links for critical areas.



Traffic Management

- The goal for a good network design is to enhance the productivity of the employees and minimize network downtime.
- The routers and switches in a small network should be configured to support real-time traffic, such as voice and video, in an appropriate manner relative to other data traffic. A good network design will implement quality of service (QoS).
- Priority queuing has four queues. The high-priority queue is always emptied first.



17.2 Small Network Applications and Protocols

Common Applications

After you have set it up, your network still needs certain types of applications and protocols in order to work. The network is only as useful as the applications that are on it.

There are two forms of software programs or processes that provide access to the network:

- **Network Applications**: Applications that implement application layer protocols and are able to communicate directly with the lower layers of the protocol stack.
- **Application Layer Services**: For applications that are not **network-aware**, the programs that interface with the network and prepare the data for transfer.

Common Protocols

Network protocols support the applications and services used by employees in a small network.

- Network administrators commonly require access to network devices and servers. The two most common remote access solutions are Telnet and Secure Shell (SSH).
- Hypertext Transfer Protocol (HTTP) and Hypertext Transfer Protocol Secure (HTTP) are used between web clients and web servers.
- Simple Mail Transfer Protocol (SMTP) is used to send email, Post Office Protocol (POP3) or Internet Mail Access Protocol (IMAP) are used by clients to retrieve email.
- File Transfer Protocol (FTP) and Security File Transfer Protocol (SFTP) are used to download and upload files between a client and an FTP server.
- Dynamic Host Configuration Protocol (DHCP) is used by clients to acquire an IP configuration from a DHCP Server.
- The Domain Name Service (DNS) resolves domain names to IP addresses.

Note: A server could provide multiple network services. For instance, a server could be an email, FTP and SSH server.

Common Protocols (Cont.)

These network protocols comprise the fundamental toolset of a network professional, defining:

- Processes on either end of a communication session.
- Types of messages.
- Syntax of the messages.
- Meaning of informational fields.
- How messages are sent and the expected response.
- Interaction with the next lower layer.

Many companies have established a policy of using secure versions (e.g., SSH, SFTP, and HTTPS) of these protocols whenever possible.

Voice and Video Applications

- Businesses today are increasingly using IP telephony and streaming media to communicate with customers and business partners, as well as enabling their employees to work remotely.
- The network administrator must ensure the proper equipment is installed in the network and that the network devices are configured to ensure priority delivery.
- The factors that a small network administrator must consider when supporting real-time applications:
  - **Infrastructure -** Does it have the capacity and capability to support real-time applications?
  - **VoIP -** VoIP is typically less expensive than IP Telephony, but at the cost of quality and features.
  - **IP Telephony -** This employs dedicated servers form call control and signaling.
  - **Real-Time Applications -** The network must support Quality of Service (QoS) mechanisms to minimize latency issues. Real-Time Transport Protocol (RTP) and Real-Time Transport Control Protocol (RTCP) and two protocols that support real-time applications.

17.3 Scale to Larger Networks

Small Network Growth

Growth is a natural process for many small businesses, and their networks must grow accordingly. Ideally, the network administrator has enough lead-time to make intelligent decisions about growing the network in alignment with the growth of the company.

To scale a network, several elements are required:

- **Network documentation** - Physical and logical topology
- **Device inventory** - List of devices that use or comprise the network
- **Budget** - Itemized IT budget, including fiscal year equipment purchasing budget
- **Traffic analysis** - Protocols, applications, and services and their respective traffic requirements should be documented

These elements are used to inform the decision-making that accompanies the scaling of a small network.

Protocol Analysis

It is important to understand the type of traffic that is crossing the network as well as the current traffic flow. There are several network management tools that can be used for this purpose.

To determine traffic flow patterns, it is important to do the following:

- Capture traffic during peak utilization times to get a good representation of the different traffic types.
- Perform the capture on different network segments and devices as some traffic will be local to a particular segment.
- Information gathered by the protocol analyzer is evaluated based on the source and destination of the traffic, as well as the type of traffic being sent.
- This analysis can be used to make decisions on how to manage the traffic more efficiently.

Employee Network Utilization

Many operating systems provide built-in tools to display such network utilization information. These tools can be used to capture a “snapshot” of information such as the following:

- OS and OS Version
- CPU utilization
- RAM utilization
- Drive utilization
- Non-Network applications
- Network applications

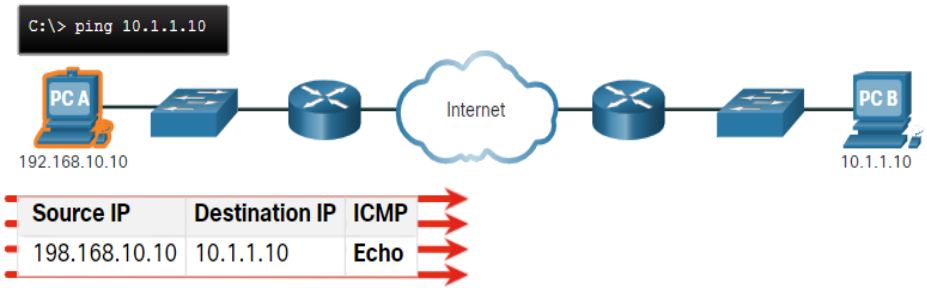
Documenting snapshots for employees in a small network over a period of time is very useful to identify evolving protocol requirements and associated traffic flows.

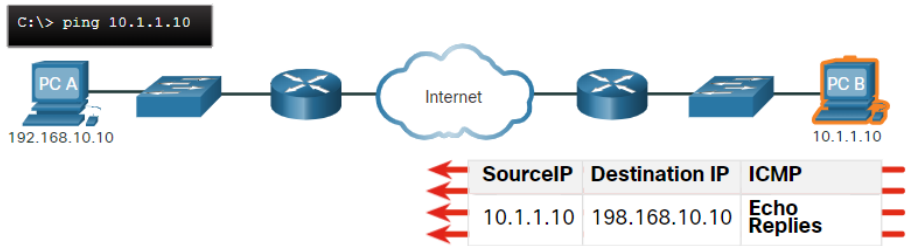
17.4 Verify Connectivity

Verify Connectivity with Ping

Whether your network is small and new, or you are scaling an existing network, you will always want to be able to verify that your components are properly connected to each other and to the internet.

- The ping command, available on most operating systems, is the most effective way to quickly test Layer 3 connectivity between a source and destination IP address.
- The ping command uses the Internet Control Message Protocol (ICMP) echo (ICMP Type 8) and echo reply (ICMP Type 0) messages.





Verify Connectivity with Ping (Cont.)

On a Windows 10 host, the ping command sends four consecutive ICMP echo messages and expects four consecutive ICMP echo replies from the destination. The IOS ping sends five ICMP echo messages and displays an indicator for each ICMP echo reply received.

IOS Ping Indicators are as follows:

Element	Description
!	•Exclamation mark indicates successful receipt of an echo reply message. •It validates a Layer 3 connection between source and destination.
.	•A period means that time expired waiting for an echo reply message. •This indicates a connectivity problem occurred somewhere along the path.
U	•Uppercase **U** indicates a router along the path responded with an ICMP Type 3 “destination unreachable” error message. •Possible reasons include the router does not know the direction to the destination network or it could not find the host on the destination network.

Note: Other possible ping replies include Q, M, ?, or &. However, the meaning of these are out of scope for this module.

Extended Ping

The Cisco IOS offers an "extended" mode of the **ping** command.

Extended ping is entered in privileged EXEC mode by typing **ping** without a destination IP address. You will then be given several prompts to customize the extended **ping**.

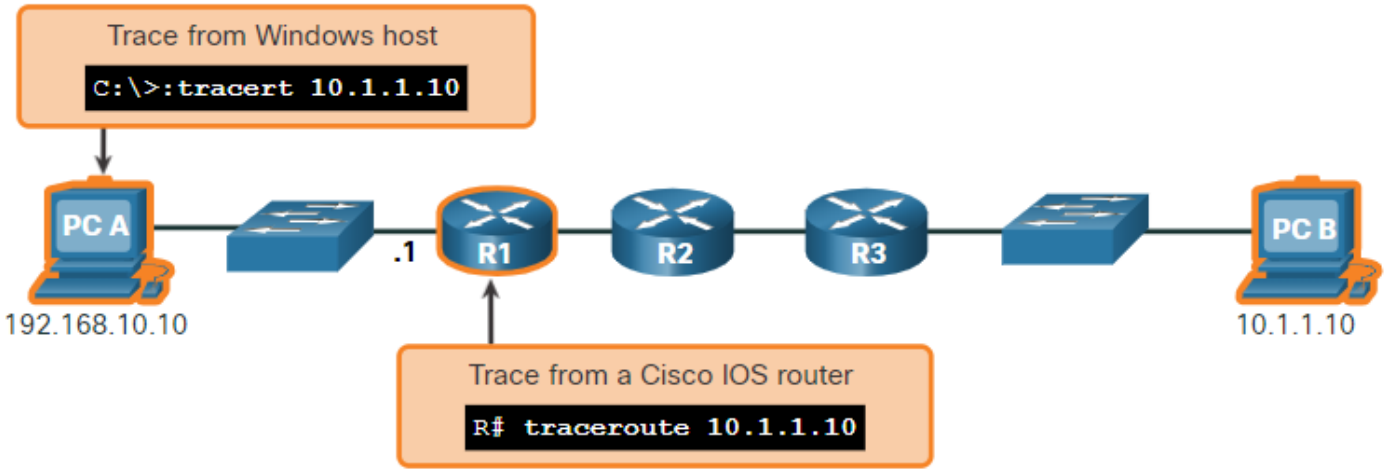
Note: Pressing **Enter** accepts the indicated default values. The **ping ipv6** command is used for IPv6 extended pings.

```
R1# ping
Protocol [ip]:
Target IP address: 10.1.1.10
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Ingress ping [n]:
Source address or interface: 192.168.10.1
DSCP Value [0]:
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0x0000ABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 192.168.10.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R1#
```

Verify Connectivity with Traceroute

The ping command is useful to quickly determine if there is a Layer 3 connectivity problem. However, it does not identify where the problem is located along the path.

- Traceroute can help locate Layer 3 problem areas in a network. A trace returns a list of hops as a packet is routed through a network.
- The syntax of the trace command varies between operating systems.



Verify Connectivity with Traceroute (Cont.)

- The following is a sample output of **tracert** command on a Windows 10 host.

  Note: Use **Ctrl-C** to interrupt a **tracert in Windows.**

- The only successful response was from the gateway on R1. Trace requests to the next hop timed out as indicated by the asterisk (*), meaning that the next hop router did not respond or there is a failure in the network path. In this example there appears to be a problem between R1 and R2.

```
C:\Users\PC-A> tracert 10.1.1.10
Tracing route to 10.1.10 over a maximum of 30 hops:
  1     2 ms     2 ms     2 ms  192.168.10.1
  2     *        *        *     Request timed out.
  3     *        *        *     Request timed out.
  4     *        *        *     Request timed out.
^C
C:\Users\PC-A>
```

Verify Connectivity with Traceroute (Cont.)

The following are sample outputs of traceroute command from R1:

```
R1# traceroute 10.1.1.10
Type escape sequence to abort.
Tracing the route to 10.1.1.10
VRF info: (vrf in name/id, vrf out name/id)
  1 209.165.200.226 1 msec 0 msec 1 msec
  2 209.165.200.230 1 msec 0 msec 1 msec
  3 10.1.1.10 1 msec 0 msec
R1#
```

```
R1# traceroute 10.1.1.10
Type escape sequence to abort.
Tracing the route to 10.1.1.10
VRF info: (vrf in name/id, vrf out name/id)
  1 209.165.200.226 1 msec 0 msec 1 msec
  2 209.165.200.230 1 msec 0 msec 1 msec
  3  *  *  *
  4  *  *  *
  5  *
```

- On the left, the trace validated that it could successfully reach PC B.
- On the right, the 10.1.1.10 host was not available, and the output shows asterisks where replies timed out. Timeouts indicate a potential network problem.
- Use **Ctrl-Shift-6** to interrupt a **traceroute** in Cisco IOS.

Note: **Windows implementation of traceroute (tracert) sends ICMP Echo Requests. Cisco IOS and Linux use UDP with an invalid port number. The final destination will return an ICMP port unreachable message.**

Extended Traceroute

Like the extended **ping** command, there is also an extended **traceroute** command. It allows the administrator to adjust parameters related to the command operation.

The Windows **tracert** command allows the input of several parameters through options in the command line. However, it is not guided like the extended traceroute IOS command. The following output displays the available options for the Windows **tracert** command:

```
C:\Users\PC-A> tracert /?
Usage: tracert [-d] [-h maximum_hops] [-j host-list] [-w timeout]
               [-R] [-S srcaddr] [-4] [-6] target_name
Options:
    -d                 Do not resolve addresses to hostnames.
    -h maximum_hops    Maximum number of hops to search for target.
    -j host-list       Loose source route along host-list (IPv4-only).
    -w timeout         Wait timeout milliseconds for each reply.
    -R                 Trace round-trip path (IPv6-only).
    -S srcaddr         Source address to use (IPv6-only).
    -4                 Force using IPv4.
    -6                 Force using IPv6.
C:\Users\PC-A>
```

Extended Traceroute (Cont.)

- The Cisco IOS extended **traceroute** option enables the user to create a special type of trace by adjusting parameters related to the command operation.
- Extended traceroute is entered in privileged EXEC mode by typing **traceroute** without a destination IP address. IOS will guide you through the command options by presenting a number of prompts related to the setting of all the different parameters.

- **Note**: Pressing **Enter** accepts the indicated default values.

```
R1# traceroute
Protocol [ip]:
Target IP address: 10.1.1.10
Ingress traceroute [n]:
Source address: 192.168.10.1
DSCP Value [0]:
Numeric display [n]:
Timeout in seconds [3]:
Probe count [3]:
Minimum Time to Live [1]:
Maximum Time to Live [30]:
Port Number [33434]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Type escape sequence to abort.
Tracing the route to 192.168.10.10
VRF info: (vrf in name/id, vrf out name/id)
  1 209.165.200.226 1 msec 1 msec 1 msec
  2 209.165.200.230 0 msec 1 msec 0 msec
  3  *
    10.1.1.10 2 msec 2 msec
R1#
```

Network Baseline

- One of the most effective tools for monitoring and troubleshooting network performance is to establish a network baseline.
- One method for starting a baseline is to copy and paste the results from an executed ping, trace, or other relevant commands into a text file. These text files can be time stamped with the date and saved into an archive for later retrieval and comparison.
- Among items to consider are error messages and the response times from host to host.
- Corporate networks should have extensive baselines; more extensive than we can describe in this course. Professional-grade software tools are available for storing and maintaining baseline information.

17.5 Host and IOS Commands

IP Configuration on a Windows Host

In Windows 10, you can access the IP address details from the **Network and Sharing Center** to quickly view the four important settings: address, mask, router, and DNS. Or you can issue the **ipconfig** command at the command line of a Windows computer.

- Use the **ipconfig /all** command to view the MAC address, as well as a number of details regarding the Layer 3 addressing of the device.
- If a host is configured as a DHCP client, the IP address configuration can be renewed using the **ipconfig /release** and **ipconfig /renew** commands.
- The DNS Client service on Windows PCs also optimizes the performance of DNS name resolution by storing previously resolved names in memory. The **ipconfig /displaydns** command displays all of the cached DNS entries on a Windows computer system.

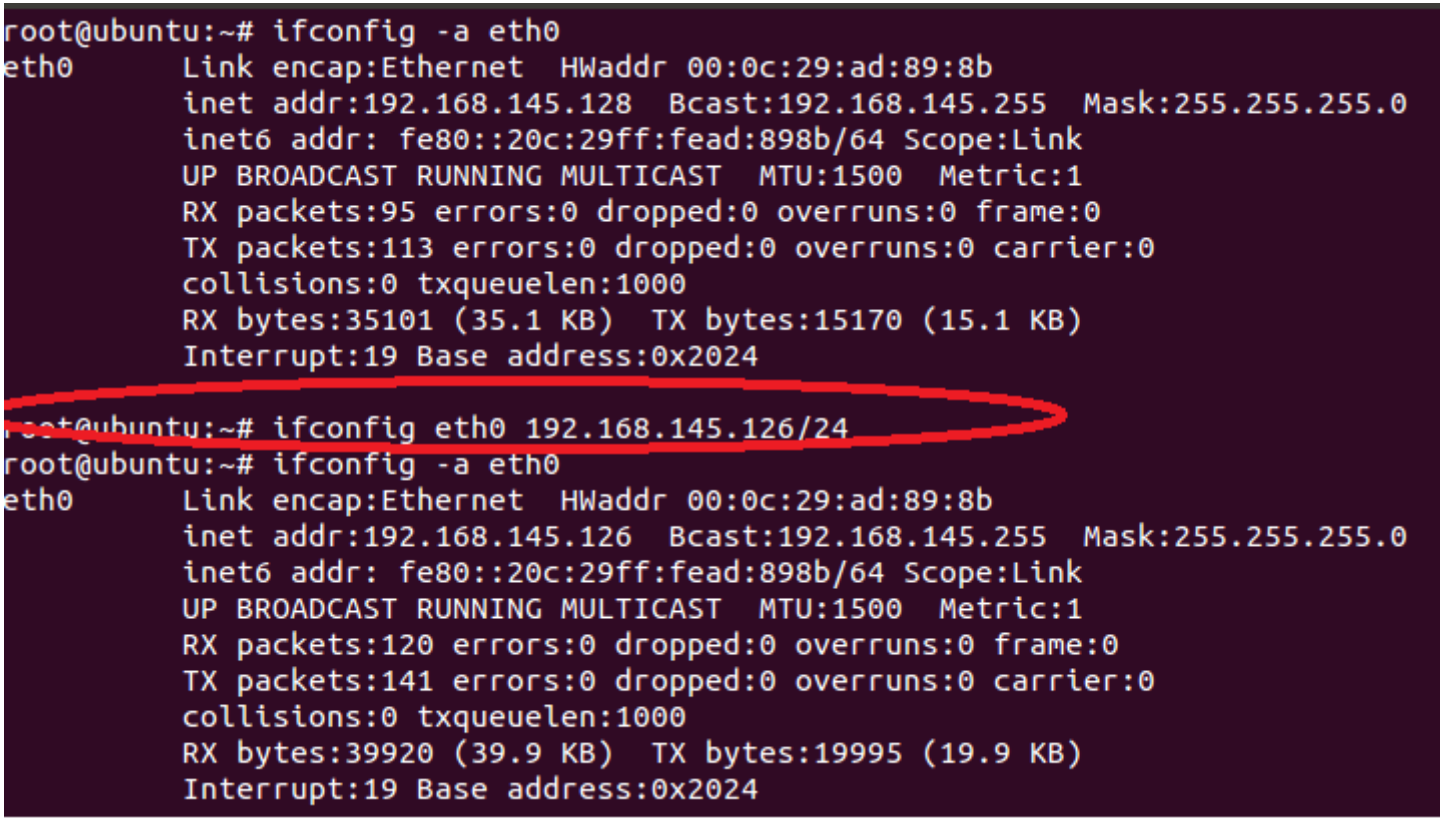
```
C:\Users\PC-A> ipconfig
Windows IP Configuration
(Output omitted)
Wireless LAN adapter Wi-Fi:
   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::a4aa:2dd1:ae2d:a75e%16
   IPv4 Address. . . . . . . . . . . : 192.168.10.10
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 192.168.10.1
(Output omitted)
```

IP Configuration on a Linux Host

- Verifying IP settings using the GUI on a Linux machine will differ depending on the Linux distribution and desktop interface.
- On the command line, use the **ifconfig** command to display the status of the currently active interfaces and their IP configuration.
- The Linux **ip address** command is used to display addresses and their properties. It can also be used to add or delete IP addresses.

```
[analyst@secOps ~]$ ifconfig
enp0s3    Link encap:Ethernet  HWaddr 08:00:27:b5:d6:cb
          inet addr: 10.0.2.15  Bcast:10.0.2.255  Mask: 255.255.255.0
          inet6 addr: fe80::57c6:ed95:b3c9:2951/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1332239 errors:0 dropped:0 overruns:0 frame:0
          TX packets:105910 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1855455014 (1.8 GB)  TX bytes:13140139 (13.1 MB)
lo: flags=73  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Note: The output displayed may vary depending on the Linux distribution.



IP Configuration on a macOS Host

- In the GUI of a Mac host, open **Network Preferences > Advanced** to get the IP addressing information.
- The **ifconfig** command can also be used to verify the interface IP configuration at the command line.
- Other useful macOS commands to verify the host IP settings include **networksetup -listallnetworkservices** and the **networksetup -getinfo <***network service***>**.

```
MacBook-Air:~ Admin$ networksetup -listallnetworkservices
An asterisk (*) denotes that a network service is disabled.
iPhone USB
Wi-Fi
Bluetooth PAN
Thunderbolt Bridge
MacBook-Air:~ Admin$
MacBook-Air:~ Admin$ networksetup -getinfo Wi-Fi
DHCP Configuration
IP address: 10.10.10.113
Subnet mask: 255.255.255.0
Router: 10.10.10.1
Client ID:
IPv6: Automatic
IPv6 IP address: none
IPv6 Router: none
Wi-Fi ID: c4:b3:01:a0:64:98
MacBook-Air:~ Admin$
```

The arp Command

The **arp** command is executed from the Windows, Linux, or Mac command prompt. The command lists all devices currently in the ARP cache of the host.

- The **arp -a** command displays the known IP address and MAC address binding. The ARP cache only displays information from devices that have been recently accessed.
- To ensure that the ARP cache is populated, **ping** a device so that it will have an entry in the ARP table.
- The **cache can be cleared** by using the **netsh interface ip delete arpcache** command in the event the network administrator wants to repopulate the cache with updated information.

Note: You may need administrator access on the host to be able to use the **netsh interface ip delete arpcache** command.

arp –d *

Common show Commands Revisited

Command	Description
show running-config	Verifies the current configuration and settings
show interfaces	Verifies the interface status and displays any error messages
show ip interface	Verifies the Layer 3 information of an interface
show arp	Verifies the list of known hosts on the local Ethernet LANs
show ip route	Verifies the Layer 3 routing information
show protocols	Verifies which protocols are operational
show version	Verifies the memory, interfaces, and licenses of the device

The show ip interface brief Command

One of the most frequently used commands is the **show ip interface brief** command. This command provides a more abbreviated output than the **show ip interface** command. It provides a summary of the key information for all the network interfaces on a router.

```
R1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   209.165.200.225 YES manual up                    up
GigabitEthernet0/0/1   192.168.10.1    YES manual up                    up
Serial0/1/0            unassigned      NO  unset  down                  down
Serial0/1/1            unassigned      NO  unset  down                  down
GigabitEthernet0       unassigned      YES unset  administratively down down
R1#
```

```
S1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
Vlan1                  192.168.254.250 YES manual up                    up
FastEthernet0/1        unassigned      YES unset  down                  down
FastEthernet0/2        unassigned      YES unset  up                    up
FastEthernet0/3        unassigned      YES unset  up                    up
```

The show cdp neighbors Command

CDP provides the following information about each CDP neighbor device:

- **Device identifiers** - The configured host name of a switch, router, or other device
- **Address list** - Up to one network layer address for each protocol supported
- **Port identifier** - The name of the local and remote port in the form of an ASCII character string, such as FastEthernet 0/0
- **Capabilities list** - Whether a specific device is a Layer 2 switch or a Layer 3 switch
- **Platform** - The hardware platform of the device.

The **show cdp neighbors detail** command reveals the IP address of a neighboring device.

```
R3# show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay
Device ID        Local Intrfce     Holdtme    Capability  Platform  Port ID
S3               Gig 0/0/1         122              S I   WS-C2960+ Fas 0/5
Total cdp entries displayed : 1
R3#
```

17.6 Troubleshooting Methodologies

Basic Troubleshooting Approaches

Step	Description
Step 1. Identify the Problem	•This is the first step in the troubleshooting process. •Although tools can be used in this step, a conversation with the user is often very helpful.
Step 2. Establish a Theory of Probable Causes	•After the problem is identified, try to establish a theory of probable causes. •This step often yields more than a few probable causes to the problem.
Step 3. Test the Theory to Determine Cause	•Based on the probable causes, test your theories to determine which one is the cause of the problem. •A technician may apply **a quick fix** to test and see if it solves the problem. •If a quick fix does not correct the problem, you might need to research the problem further to establish the exact cause.
Step 4. Establish a Plan of Action and Implement the Solution	After you have determined the exact cause of the problem, establish a plan of action to resolve the problem and implement the solution.
Step 5. Verify Solution and Implement Preventive Measures	•After you have corrected the problem, verify full functionality. •If applicable, implement preventive measures.
Step 6. Document Findings, Actions, and Outcomes	•In the final step of the troubleshooting process, document your findings, actions, and outcomes. •This is very important for future reference.

Resolve or Escalate?

- In some situations, it may not be possible to resolve the problem immediately. A problem should be escalated when it requires a manager decision, some specific expertise, or network access level unavailable to the troubleshooting technician.
- A company policy should clearly state when and how a technician should escalate a problem.

The debug Command

- The IOS **debug** command allows the administrator to display OS process, protocol, mechanism and event messages in real-time for analysis.
- All **debug** commands are entered in privileged EXEC mode. The Cisco IOS allows for narrowing the output of **debug** to include only the relevant feature or subfeature. Use **debug** commands only to troubleshoot specific problems.
  - To list a brief description of all the debugging command options, use the **debug ?** command in privileged EXEC mode at the command line.
  - To turn off a specific debugging feature, add the **no** keyword in front of the **debug** command
  - Alternatively, you can enter the **undebug** form of the command in privileged EXEC mode.
  - To turn off all active debug commands at once, use the **undebug all** command.
- Be cautious using some **debug** commands, as they may generate a substantial amount of output and use a large portion of system resources. The router could get so busy displaying **debug** messages that it would not have enough processing power to perform its network functions, or even listen to commands to turn off debugging.

The terminal monitor Command

- **debug** and certain other IOS message output is not automatically displayed on remote connections. This is because log messages are prevented from being displayed on vty lines.
- To display log messages on a terminal (virtual console), use the **terminal monitor** privileged EXEC command. To stop logging messages on a terminal, use the **terminal no monitor** privileged EXEC command.

```
R2# telnet 209.165.200.225
Trying 209.165.200.225 ... Open
 Authorized access only!
User Access Verification
Password:
R1> enable
Password:
R1# debug ip icmp
ICMP packet debugging is on
R1# ping 10.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R1#
```

```
R1#  terminal monitor
R1# ping 10.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/2 ms
R1#
*Aug 20 16:03:49.735: ICMP: echo reply rcvd, src 10.1.1.1, dst 209.165.200.225,topology BASE, dscp 0
topoid 0
**Aug 20 16:03:49.737: ICMP: echo reply rcvd, src 10.1.1.1, dst 209.165.200.225,topology BASE, dscp 0
topoid 0
**Aug 20 16:03:49.738: ICMP: echo reply rcvd, src 10.1.1.1, dst 209.165.200.225,topology BASE, dscp 0
topoid 0
**Aug 20 16:03:49.740: ICMP: echo reply rcvd, src 10.1.1.1, dst 209.165.200.225,topology BASE, dscp 0
topoid 0
**Aug 20 16:03:49.741: ICMP: echo reply rcvd, src 10.1.1.1, dst 209.165.200.225,topology BASE, dscp 0
topoid 0
R1# no debug ip icmp
ICMP packet debugging is off
R1#
```

17.7 Troubleshooting Scenarios

Duplex Operation and Mismatch Issues

- Interconnecting Ethernet interfaces must operate in the same duplex mode for best communication performance and to avoid inefficiency and latency on the link.
- The Ethernet autonegotiation feature facilitates configuration, minimizes problems and maximizes link performance between two interconnecting Ethernet links. The connected devices first announce their supported capabilities and then choose the highest performance mode supported by both ends.
- **If one of the two connected devices is operating in full-duplex and the other is operating in half-duplex, a duplex mismatch occurs.** While data communication will occur through a link with a duplex mismatch, link performance will be very poor.
- Duplex mismatches are typically caused by a misconfigured interface or in rare instances by a failed autonegotiation. Duplex mismatches may be difficult to troubleshoot as the communication between devices still occurs.

IP Addressing Issues on IOS Devices

- Two common causes **of incorrect IPv4 assignment** are manual assignment mistakes or DHCP-related issues.
- Network administrators often have to manually assign IP addresses to devices such as servers and routers. If a mistake is made during the assignment, then communications issues with the device are very likely to occur.
- On an IOS device, use the **show ip interface** or **show ip interface brief** commands to verify what IPv4 addresses are assigned to the network interfaces. For example, issuing the **show ip interface brief** command as shown would validate the interface status on R1.

```
R1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   209.165.200.225 YES manual up                    up
GigabitEthernet0/0/1   192.168.10.1    YES manual up                    up
Serial0/1/0            unassigned      NO  unset  down                  down
Serial0/1/1            unassigned      NO  unset  down                  down
GigabitEthernet0       unassigned      YES unset  administratively down down
R1#
```

IP Addressing Issues on End Devices

- On Windows-based machines, when the **device cannot contact a DHCP server**, Windows will automatically assign an address belonging to the **169.254.0.0/16 range**. This feature is called **Automatic Private IP Addressing (APIPA).**
- A computer with an APIPA address will not be able to communicate with other devices in the network because those devices will most likely not belong to the 169.254.0.0/16 network.
  - **Note**: Other operating systems, such Linux and OS X, do not use APIPA.
- **If the device is unable to communicate with the DHCP server, then the server cannot assign an IPv4 address for the specific network and the device will not be able to communicate.**
- To verify the IP addresses assigned to a Windows-based computer, use the **ipconfig** command.

Default Gateway Issues

- The default gateway for an end device is the closest networking device, belonging to the same network as the end device, that can forward traffic to other networks. If a device has an incorrect or nonexistent default gateway address, it will not be able to communicate with devices in remote networks.
- Similar to IPv4 addressing issues, default gateway problems can be related to **misconfiguration** (in the case of manual assignment) or **DHCP problems** (if automatic assignment is in use).
- To verify the default gateway on Windows-based computers, use the **ipconfig** command.
- On a router, use the **show ip route** command to list the routing table and verify that the default gateway, known as a default route, has been set. This route is used when the destination address of the packet does not match any other routes in its routing table.

Troubleshooting DNS Issues

- It is common for users to mistakenly relate the operation of an internet link to the availability of the DNS.
- DNS server addresses can be manually or automatically assigned via DHCP.
- Although it is common for companies and organizations to manage their own DNS servers, any reachable DNS server can be used to resolve names.
- Cisco offers OpenDNS which provides secure DNS service by filtering phishing and some malware sites. **OpenDNS addresses are 208.67.222.222 and 208.67.220.220.** Advanced features such as web content filtering and security are available to families and businesses.
- Use the **ipconfig /all** as shown to verify which DNS server is in use by the Windows computer.
- The **nslookup** command is another useful DNS troubleshooting tool for PCs. With **nslookup** a user can manually place DNS queries and analyze the DNS response.

17.8 Module Practice and Quiz

What Did I Learn In This Module (Cont.)?

- Common show commands are **show running-config**, **show interfaces**, **show ip address**, **show arp**, **show ip route**, **show protocols**, and **show version**. The **show cdp neighbor** command provides the following information about each CDP neighbor device: identifiers, address list, port identifier, capabilities list, and platform.
- The **show cdp neighbors detail** command will help determine if one of the CDP neighbors has an IP configuration error.
- The **show ip interface brief** command output displays all interfaces on the router, the IP address assigned to each interface, if any, and the operational status of the interface.
- The six basic steps to troubleshooting Step 1. Identify the problem Step 2. Establish a theory of probably causes. Step 3. Test the theory to determine the cause. Step 4. Establish a plan of action and implement the solution. Step 5. Verify the solution and implement preventive measures. Step 6. Document findings, actions, and outcomes.
- A problem should be escalated when it requires a decision of a manager, some specific expertise, or network access level unavailable to the troubleshooting technician.
- OS processes, protocols, mechanisms and events generate messages to communicate their status. The IOS debug command allows the administrator to display these messages in real-time for analysis.
- To display log messages on a terminal (virtual console), use the terminal monitor privileged EXEC command.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