



# ***25D Linux Foundation Course***

## **09 – Managing Linux Network Settings**



# Overview



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- ☐ Configuring network addressing parameters
- ☐ Troubleshooting network problems



# Installing the Ethernet Board (Network Adapter)



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- ❑ Verify that the appropriate kernel module has been loaded and that an alias has been created for the adapter

```
openSUSE:~ # ifconfig
enp0s3  Link encap:Ethernet  HWaddr 08:00:27:A6:91:FB
        inet addr:10.0.2.15  Bcast:10.0.2.255  Mask:255.255.255.0
        inet6 addr: fe80::a00:27ff:fea6:91fb/64  Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:3 errors:0 dropped:0 overruns:0 frame:0
        TX packets:65 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:1240 (1.2 Kb)  TX bytes:11943 (11.6 Kb)
```

- ❑ Location for the kernel module varies
  - /etc/modprobe.conf, /etc/modules.conf, or /etc/modprobe.d

```
openSUSE:/etc/modprobe.d # ls
00-system.conf      50-bluetooth.conf  50-iwlagn.conf
50-alsa.conf        50-ipw2200.conf    50-prism54.conf
50-blacklist.conf  50-iwl13945.conf   99-local.conf
```

- ❑ Systems that use init aliases for the network adapters:
  - eth0 The first Ethernet adapter in your system
  - eth1 The second Ethernet adapter in your system
  - eth2 The third Ethernet adapter in your system, and so on...



# Predictable Network Interface Names



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## ❑ Newer distributions with systemd use predictable network interface names as opposed to aliases:

– the alias eno1 is broken down as follows:

- en      Ethernet interface
- o1      Onboard device index number 1

– ens1 is broken down as follows:

- en      Ethernet interface
- s1      Hot-plug slot index number 1

– If the preceding options are not applicable, then systemd will try to construct an alias using the name of the physical connector. enp2s0 is broken down as follows:

- en      Ethernet interface
- p2      Bus number 2
- s0      Slot number on the bus



# Predictable Network Interface Names



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- ☐ If all else fails, systemd will try to use the interface's MAC address to construct an alias.
  - The format is enx followed by the MAC address
- ☐ Not every adapter is going to be a standard Ethernet interface
- ☐ Other types of devices use different naming conventions:
  - en            Ethernet adapters
  - sl            Serial line IP interfaces
  - wl            WLAN interfaces



# Configuring IPv4 Parameters

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Option	Description	Advantages	Disadvantages
Static address assignment	In this configuration, you manually configure a network host with IP address parameters.	The address used by a particular host never changes. This option is generally used by servers in the network.	The host consumes the address regardless of whether the system is powered on or off. This strategy also requires a lot of legwork on the part of the system administrator. He or she has to visit each computer in the network and manually specify IP parameters.
Dynamic address assignment	In this configuration, a network host contacts a Dynamic Host Configuration Protocol (DHCP) server when it boots. The DHCP server dynamically assigns an IP address to the host for a specified period of time called a lease.	This option makes configuring IP parameters for a large number of network hosts very easy. Just power the system on, and it gets its IP address information. It also conserves IP address usage. Addresses used by systems that are powered off can be reassigned to other network hosts.	You must have a DHCP server installed and configured before you can use this option. In addition, the address assigned to a particular host can change frequently, making it an unsuitable option for network infrastructure systems such as servers. Because of this, this option is generally used for workstations.



# Configuring IPv4 Parameters

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- ❑ You can use the `ifconfig` utility with no options to view the systems network interface configurations:

```
openSUSE:~ # ifconfig
enp0s3  Link encap:Ethernet  HWaddr 08:00:27:A6:91:FB
        inet addr:10.0.2.15  Bcast:10.0.2.255  Mask:255.255.255.0
        inet6 addr: fe80::a00:27ff:fea6:91fb/64 Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:3 errors:0 dropped:0 overruns:0 frame:0
        TX packets:65 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:1240 (1.2 Kb)  TX bytes:11943 (11.6 Kb)

lo      Link encap:Local Loopback
        inet addr:127.0.0.1  Mask:255.0.0.0
        inet6 addr: ::1/128 Scope:Host
        UP LOOPBACK RUNNING  MTU:65536  Metric:1
        RX packets:8 errors:0 dropped:0 overruns:0 frame:0
        TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:0
        RX bytes:632 (632.0 b)  TX bytes:632 (632.0 b)
```



# Configuring IPv4 Parameters

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- ❑ The ifconfig with options can be used to configure network interfaces
- ❑ Syntax for assigning static IP addresses using the ifconfig command:

```
openSUSE:/etc/modprobe.d # ifconfig enp0s3 10.0.3.15 netmask 255.255.255.0 broad  
cast 10.0.3.254  
openSUSE:/etc/modprobe.d # ifconfig  
enp0s3      Link encap:Ethernet  HWaddr 08:00:27:A6:91:FB  
            inet addr:10.0.3.15  Bcast:10.0.3.254  Mask:255.255.255.0  
            inet6 addr: fe80::a00:27ff:fea6:91fb/64 Scope:Link  
            UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
            RX packets:3 errors:0 dropped:0 overruns:0 frame:0  
            TX packets:121 errors:0 dropped:0 overruns:0 carrier:0  
            collisions:0 txqueuelen:1000  
            RX bytes:1240 (1.2 Kb)  TX bytes:22655 (22.1 Kb)
```





# Configuring IPv4 Parameters

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- ☐ The syntax example from the last slide will not create a persistent configuration
  - To make the assignment persistent we have to edit the configuration file for the network interface (this may vary depending on the distribution being used)
- ☐ The network interface's config file typically starts with “ifcfg” followed by the alias
  - e.g. ifcfg-ens1 (the configuration file may also be named using the MAC address of the interface as well)

```
openSUSE:/etc/sysconfig/network # ls
config  if-down.d  ifcfg-enp0s3  ifcfg.template  providers
dhcp    if-up.d    ifcfg-lo      ifroute-lo       scripts
```



# Configuring IPv4 Parameters

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## ❑ Example configuration file:

```
openSUSE:~ # cat /etc/sysconfig/network/ifcfg-enp0s3
BOOTPROTO="static"
BROADCAST="10.120.1.255"
ETHTOOL_OPTIONS=''
IPADDR="10.120.1.19"
MTU=''
NAME="82540EM Gigabit Ethernet Controller"
NETMASK="255.255.255.0"
NETWORK="10.120.1.0"
REMOTE_IPADDR=''
STARTMODE='auto'
USERCONTROL='no'
```

- ❑ In the above example the BOOTPROTO is set to static another option could be dhcp
- ❑ The MTU is left empty and by default will be 1500



# Configuring IPv4 Parameters



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- ❑ Some configuration options for network configuration files:

Option	Description	Other Possible Values
BOOTPROTO="static"	This option specifies that the interface use a static IP address assignment.	Set to <b>dhcp</b> to dynamically assign an address.
STARTMODE="auto"	This option specifies that the interface be brought online when the system is booted.	Set to <b>manual</b> to manually start the interface. Some distributions use <b>onboot</b> instead of <b>auto</b> .
IPADDR="192.168.1.81/24"	Assigns an IP address of 192.168.1.10 to the interface with a subnet mask of 255.255.255.0.	
NETMASK="subnet_mask"	If the prefix isn't assigned using CIDR notation in the IPADDR parameter, you can use NETMASK= to assign a subnet mask to the interface.	
NETWORK="192.168.1.0"	Specifies the network address of the segment that the interface is connected to.	
BROADCAST="192.168.1.255"	Specifies the broadcast address of the segment the interface is connected to.	
REMOTE_IPADDR=	Specifies the IP address of the remote node in a peer-to-peer type of connection.	
MTU=	Specifies the size of the Maximum Transmission Unit (which is 1500 by default on an Ethernet network).	If your network uses jumbo frames, you can set this parameter to <b>9000</b> .
ETHTOOL_OPTIONS=	Specifies command arguments used by the ethtool utility.	
LABEL_0='0' IPADDR_0='2607:f 0d0:1002:0011:0000:0000:0003' PREFIXLEN_0='64'	These parameters are used to assign an IPv6 address to the eth0 interface.	



# Configuring IPv4 Parameters

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- ❑ After making changes to the interface configuration files, the network interface needs to be restarted

```
openSUSE:/etc/sysconfig/network # ifdown enp0s3  
openSUSE:/etc/sysconfig/network # ifup enp0s3
```

- ❑ You can automatically pull an address from a DHCP server using the dhclient utility (dhclient enp0s3)
- ❑ Another utility that can be used to manage IP addressing is the ip command:
  - ip addr add ip\_address dev interface
  - ip addr del ip\_address dev interface
- ❑ To enable and disable an interface:
  - ip link set interface down
  - ip link set interface up



# **Exercise 9-1: Working with Network Interfaces**



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**Please open your Practical Exercise book to  
Exercise 9-1.**

**Time to Complete: 5 Minutes**



# Configuring Routing Parameters

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- ❑ So far we have not configured two important network settings:
  - Default Gateway
  - DNS server settings
- ❑ The Default Gateway is not an interface setting and is actually a global setting set in `/etc/sysconfig/network/routes`

```
openSUSE:~ # cat /etc/sysconfig/network/routes  
default 10.120.1.254 - enp0s3
```
- ❑ The routes file is not in this directory by default
  - The above file was made by using Yast in the GUI and setting the default gateway
  - It can be configured via the CLI as well



# Configuring Routing Parameters

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- ☐ The routes file has 5 columns:

```
openSUSE:~ # cat /etc/sysconfig/network/routes  
default 10.120.1.254 - enp0s3
```

- ☐ The first column is the routes destination
  - This may be an IP address, DNS hostname of a network or a host
  - Entering default simply means the route is the default route
- ☐ The second column is the IP address of the default gateway
- ☐ The third column is the netmask
  - Placing a dash (-) means it is empty
- ☐ The fourth column is the interface the route applies
  - Leaving it blank will apply the route to all interfaces
- ☐ The fifth column is optional but can specify a route type (unicast, multicast, broadcast, local and unreachable)



# Configuring Routing Parameters

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- ❑ The routes file can be created in the CLI within the `/etc/sysconfig/network` directory via vi or another text editor:

```
default 10.120.1.254 255.255.255.0 enp0s3
```

- ❑ You can verify the route was added to the hosts routing table by entering the route command:

```
openSUSE:~ # route
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
default          10.120.1.254   0.0.0.0         UG    0      0      0 enp0s3
10.120.1.0       *              255.255.255.0   U     0      0      0 enp0s3
loopback         *              255.0.0.0       U     0      0      0 lo
```

- ❑ In this example you see three entries in the routing table one for the default gateway (.254), one for the local network (.0) and the loopback
  - The flags in this example are U for up, G for gateway
  - The star for Gateway means one is not set in that route





# Configuring Routing Parameters

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- ❑ The route utility has other options that can be used to add and delete routes and gateways to the hosts routing table
  - These will not be persistent by default
  - Adding a route:
    - Example: `route add -net 10.120.1.0 netmask 255.255.255.0 gw 10.120.1.254` would create the route seen in the prior slide (not in the route file)
  - Deleting a route:
    - Example: `route del -net 10.120.1.0 netmask 255.255.255.0 gw 10.120.1.254` would delete the route from the above example
  - Adding a default route:
    - Example: `route add default gw 10.120.1.254`
    - The del option would delete the default route



# Configuring Routing Parameters

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- ❑ Examples of adding and removing routes from routing tables:

```

openSUSE:~ # route
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
default          10.120.1.254    0.0.0.0         UG      0      0      0 enp0s3
10.120.1.0       *               255.255.255.0   U        0      0      0 enp0s3
loopback         *               255.0.0.0       U        0      0      0 lo
openSUSE:~ # route del default gw 10.120.1.254
openSUSE:~ # route
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
10.120.1.0       *               255.255.255.0   U        0      0      0 enp0s3
loopback         *               255.0.0.0       U        0      0      0 lo
openSUSE:~ # route add default gw 10.120.1.254
openSUSE:~ # route
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref    Use Iface
default          10.120.1.254    0.0.0.0         UG      0      0      0 enp0s3
10.120.1.0       *               255.255.255.0   U        0      0      0 enp0s3
loopback         *               255.0.0.0       U        0      0      0 lo
  
```

- ❑ This original default route was added to the route file in the /etc/sysconfig/network directory. Upon deletion it would be gone, until a reboot when it would be added again from the route file to the route table.



# **Exercise 9-2: Configuring the Default Gateway**



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**Please open your Practical Exercise book to  
Exercise 9-2.**

**Time to Complete: 5 Minutes**



# Configuring Name Resolver Settings



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- ☐ /etc/hosts file is used by the local machine to resolve hostnames to IP addresses
- ☐ The hosts file contains one line per host record:

```
# hosts      This file describes a number of hostname-to-address
#            mappings for the TCP/IP subsystem.  It is mostly
#            used at boot time, when no name servers are running.
#            On small systems, this file can be used instead of a
#            "named" name server.
# Syntax:
#
# IP-Address  Full-Qualified-Hostname  Short-Hostname
#
127.0.0.1     localhost
#
# special IPv6 addresses
::1           localhost ipv6-localhost ipv6-loopback
```



# Configuring Name Resolver Settings



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- ❑ To provide the system with the IP address of the DNS server that you want to use, edit the `/etc/resolv.conf` file
  - Two entries in this file
    - `search` - Specifies the domain name that should be used to fill out incomplete hostnames
    - `nameserver` - Specifies the IP address of the DNS server you want to use for name resolution

```
openSUSE:/etc/sysconfig/network # cat /etc/resolv.conf
### /etc/resolv.conf file autogenerated by netconfig!
#
# Before you change this file manually, consider to define the
# static DNS configuration using the following variables in the
# /etc/sysconfig/network/config file:
#   NETCONFIG_DNS_STATIC_SEARCHLIST
#   NETCONFIG_DNS_STATIC_SERVERS
#   NETCONFIG_DNS_FORWARDER
# or disable DNS configuration updates via netconfig by setting:
#   NETCONFIG_DNS_POLICY=""
#
# See also the netconfig(8) manual page and other documentation.
#
# Note: Manual change of this file disables netconfig too, but
# may get lost when this file contains comments or empty lines
# only, the netconfig settings are same with settings in this
# file and in case of a "netconfig update -f" call.
#
### Please remove (at least) this line when you modify the file!
search mysite.com
nameserver 10.255.1.230
```

- ❑ Use the `/etc/nsswitch.conf` file to define the order in which services will be used for name resolution



# **Exercise 9-3: Configuring the Default Gateway**



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**Please open your Practical Exercise book to  
Exercise 9-3.**

**Time to Complete: 5 Minutes**



# Using a Standardized Troubleshooting Model



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- ☐ **Step 1. Gather information.** This is a critical step. You need to determine exactly what has happened. What are the symptoms? Were any error messages displayed? What did they say? How extensive is the problem? Is it isolated to a single system, or are many systems experiencing the same problem?
- ☐ **Step 2. Identify what has changed.** In this step, you should identify what has changed in the system. Has new software been installed? Has new hardware been installed? Did a user change something? Did you change something?
- ☐ **Step 3. Create a hypothesis.** With the information gathered in the preceding steps, develop several hypotheses that could explain the problem. To do this, you may need to do some research. You should check FAQs and knowledge bases available on the Internet. You should also consult with peers to validate your hypotheses. Using the information you gain, narrow your results down to the one or two most likely causes.
- ☐ **Step 4. Determine the appropriate fix.** The next step is to use peers, FAQs, knowledge bases, and your own experience to identify the steps needed to fix the problem. As you do this, be sure to identify the possible ramifications of implementing the fix and account for them. Many times, the fix may have side effects that are as bad as or worse than the original problem.



# Using a Standardized Troubleshooting Model



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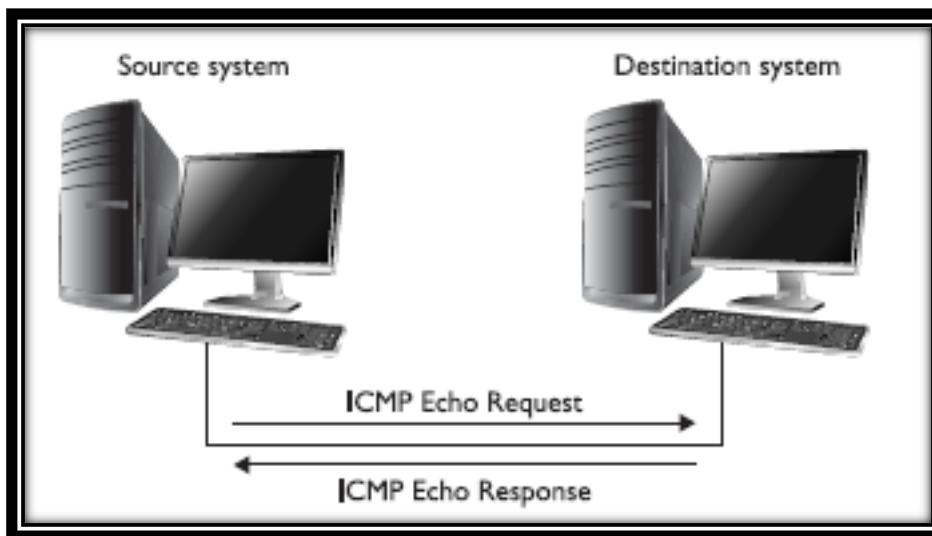
- ☐ **Step 5. Implement the fix.** At this point, you're ready to implement the fix. Notice that in this troubleshooting model, we did a ton of research before implementing a fix! Doing so greatly increases the likelihood of success. After implementing the fix, be sure to verify that the fix actually repaired the problem and that the issue doesn't reappear.
  
- ☐ **Step 7. Document the solution.** Finally, you need to document the solution to your problem. That way, if it occurs again a year or two down the road, you or other system administrators can quickly identify the problem and how to fix it.





# Using ping

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```
root@openSUSE:/  
File Edit View Search Terminal Help  
openSUSE:/ # ping www.google.com  
PING www.google.com (74.125.239.144) 56(84) bytes of data.  
64 bytes from nuq05s02-in-f16.1e100.net (74.125.239.144): icmp_seq=1 ttl=54 time=30.7 ms  
64 bytes from nuq05s02-in-f16.1e100.net (74.125.239.144): icmp_seq=2 ttl=54 time=31.2 ms  
64 bytes from nuq05s02-in-f16.1e100.net (74.125.239.144): icmp_seq=3 ttl=54 time=30.9 ms  
64 bytes from nuq05s02-in-f16.1e100.net (74.125.239.144): icmp_seq=4 ttl=54 time=31.5 ms  
64 bytes from nuq05s02-in-f16.1e100.net (74.125.239.144): icmp_seq=5 ttl=54 time=29.5 ms
```



# Using netstat



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- ❑ The netstat utility is another powerful tool in your virtual toolbox. This utility can do the following:
  - List network connections
  - Display your routing table
  - Display information about your network interface

netstat Option	Description
-a	Lists all listening and nonlistening sockets
-i	Displays statistics for your network interfaces
-l	Lists listening sockets
-s	Displays summary information for each protocol
-r	Displays your routing table

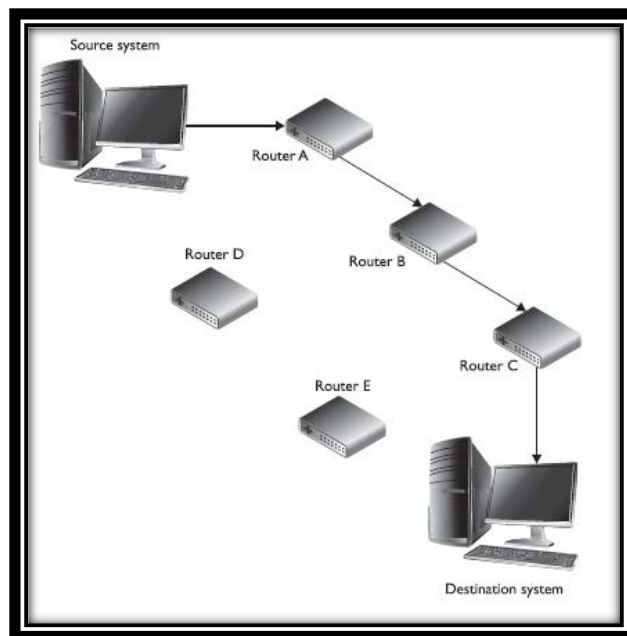


# Using traceroute



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- ❑ Traceroute can trace a packet as it goes from hop to hop across different networks from the source to the destination:



- ❑ The syntax is simple `traceroute destination _hostname or IP address`
- ❑ The traceroute utility will create one line for each router the packets cross on the way to the destination



# Using Name Resolution Tools

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## ☐ Domain Information Groper (dig)

- Used to perform a DNS lookup on your DNS server and display detailed information about the hostname being resolved and about the DNS server itself.

### – Options

- a Resolve A record information
- ptr Resolve a PTR record
- cname Resolve CNAME record information
- in Resolve Internet record information
- mx Resolve MX record information
- soa Resolve start of authority information

## ☐ The host command can be used to resolve hostnames

## ☐ The gentent command can be used to query data from configuration files on the local system



# **Exercise 9-4: Working with Network Commands**



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**Please open your Practical Exercise book to  
Exercise 9-4.**

**Time to Complete: 5 Minutes**



# Summary



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- ☐ Configuring network addressing parameters
- ☐ Troubleshooting network problems



# Questions

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# Questions?



# Check on Learning



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## Question 1

**You just installed a second Ethernet board in an older Linux system. What alias is assigned to this interface by default?**

- A. eth0**
- B. eth1**
- C. eth2**
- D. eth3**





# Check on Learning



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## Question 2

You need to use `ifconfig` to assign an IP address of `176.23.0.12` and a subnet mask of `255.255.0.0` to your `eth0` interface. Which of the following commands will do this?

- A. `ifconfig eth0 176.23.0.12 netmask 255.255.0.0`
- B. `ifconfig 176.23.0.12 netmask 255.255.0.0`
- C. `ifconfig eth0 176.23.0.12 mask 255.255.0.0`
- D. `ifconfig dev=eth0 ipaddr=176.23.0.12  
subnetmask=255.255.0.0`



# Check on Learning



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## Question 3

**You need to make a permanent, static IP address assignment for your eth0 network interface, which has a MAC address of 00:0C:29:B1:50:A4. Which file do you need to edit to do this, depending on your particular distribution? (Choose two.)**

- A. `/etc/sysconfig/network/eth0/ifcfg-eth-id-00:0C:29:B1:50:A4`**
- B. `/etc/sysconfig/network/00:0C:29:B1:50:A4/eth0`**
- C. `/etc/sysconfig/network/ifcfg-eth0`**
- D. `/etc/sysconfig/network/ifcfg-eth-id-00:0C:29:B1:50:A4`**
- E. `/etc/sysctl/network/ifcfg-eth-id-00:0C:29:B1:50:A4`**



# Check on Learning



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## Question 4

**Which option in your eth0 network interface configuration file should you use to configure the NIC to get its IP address information dynamically from a DHCP server?**

- A. STARTMODE**
- B. BOOTPROTO**
- C. IPADDR**
- D. DHCP**



# Check on Learning



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## Question 5

**You've opened your `/etc/sysconfig/network/routes` file in the vi editor. You want to specify a default gateway router address of 10.200.200.254. Which of the following directives would you enter in this file to do this?**

- A. `default 10.200.200.254`**
- B. `gw_addr 10.200.200.254`**
- C. `gateway 10.200.200.254`**
- D. `router 10.200.200.254`**



# Check on Learning



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## Question 6

**You've opened your `/etc/resolv.conf` file in the vi editor. You want to specify a DNS server address of `10.200.200.1`. Which of the following directives would you enter in this file to do this?**

- A. `host 10.200.200.1`**
- B. `resolver 10.200.200.1`**
- C. `dnsserver 10.200.200.1`**
- D. `nameserver 10.200.200.1`**



# Check on Learning



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## Question 7

**You want to use your organization's DHCP server to dynamically assign an IP address to your ens1 network interface. Which of the following commands would you enter at the shell prompt to do this?**

- A. `dhcp ens1`**
- B. `dhclient ens1`**
- C. `get address dynamic ens1`**
- D. `ip address=dhcp dev= ens1`**



# Check on Learning

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## Question 8

You want to temporarily disable the second interface in an older Linux system. Which of the following commands would you enter at the shell prompt to do this?

- A. `ifdown eth1`
- B. `ifdown eth0`
- C. `ifdown eth2`
- D. `ifconfig disable dev eth1`



# Check on Learning

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## Question 9

You need to verify that a remote host with a hostname of fs1.mycorp.com is up and running. Which of the following commands would you enter at the shell prompt to do this?

- A. `finger fs1.mycorp.com`
- B. `ping fs1.mycorp.com`
- C. `netstat -s fs1.mycorp.com`
- D. `verify fs1.mycorp.com`





# Check on Learning



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## Question 10

Which of the following commands will add a default gateway router address of 10.200.200.254 to your route table?

- A. `route 10.200.200.254`
- B. `route add default gw 10.200.200.254`
- C. `netstat -a default 10.200.200.254`
- D. `gateway 10.200.200.254`