Virtual Cabling

VMware Cabling

Joining a Network

Showing and Controlling Interfaces
Show and Control Routes
NetworkManager

IPCalc - to calculate netmasks and more

Temporary Interface Configuration Using DHCP
Temporary Interface Configuration Using Static IP addresses

Temporary Route configuration

redhat	debian
Permanent Interface Configuration Permanent Routing Table Configuration Permanent Hostname Configuration	Permanent Network Configuration Permanent Hostname Configuration

Name Resolution

Connectivity Testing

Making Routers

Packet Forwarding

Firewalls and NAT

Firewalls Firewalls (Red Hat Family) Firewall - Lab 5 Firewall - SSH Brute Force Attack Blocker	NAT Favorites NAT Port Forwarding

Network Services

Telnet FTP	10 Steps for Installation

Other

General Linux commands - root & shutdown General Linux commands - basic inventory Installing more commands	Packet Sniffing SSH Tunneling (Port Forwarding) SELinux
ARP commands	Linux hardware and driver commands

VMware

	VMware commands and operations

IP Addressing

ipcalc - utility for calculating addresses and size of IP networks

debian

Example: (Ubuntu)

ipcalc 192.168.16.0/22

```
Address:   192.168.16.0         11000000.10101000.000100 00.00000000
Netmask:   255.255.252.0 = 22   11111111.11111111.111111 00.00000000
Wildcard:  0.0.3.255            00000000.00000000.000000 11.11111111
=>
Network:   192.168.16.0/22      11000000.10101000.000100 00.00000000
HostMin:   192.168.16.1         11000000.10101000.000100 00.00000001
HostMax:   192.168.19.254       11000000.10101000.000100 11.11111110
Broadcast: 192.168.19.255       11000000.10101000.000100 11.11111111
Hosts/Net: 1022                  Class C, Private Internet
```

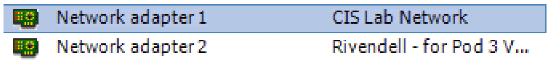
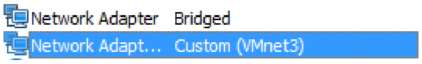
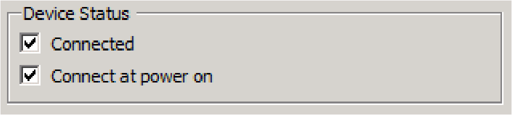
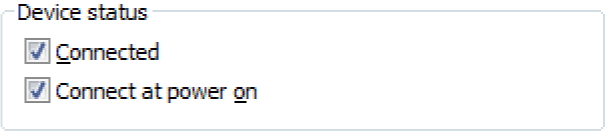
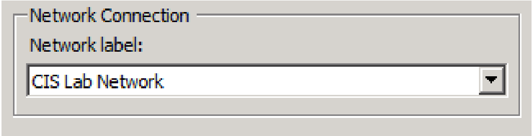
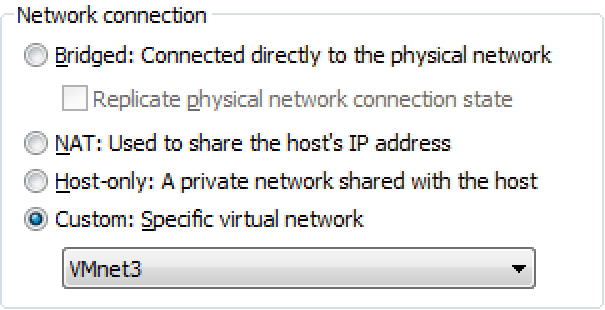
redhat

Example: (Red Hat family)

ipcalc -npmb 192.168.16.0/22

```
NETMASK=255.255.252.0
PREFIX=22
BROADCAST=192.168.19.255
NETWORK=192.168.16.0
```

top

<table>
<tr><th colspan="2">Virtual Cabling</th></tr>
<tr><th>VMware ESXi/vSphere</th><th>VMware Workstation</th></tr>
<tr><td colspan="2"><em>In VM Settings ..., select the network adapter (NIC) to cable</em></td></tr>
<tr><td>
Network adapter 1 CIS Lab Network
Network adapter 2 Rivendell - for Pod 3 V...</td><td>
Network Adapter Bridged
Network Adapt... Custom (VMnet3)</td></tr>
<tr><td colspan="2"><em>Connect or disconnect the adapter</em></td></tr>
<tr><td>
Device Status
☑ Connected
☑ Connect at power on</td><td>
Device status
☑ Connected
☑ Connect at power on</td></tr>
<tr><td colspan="2"><em>Select a network to connect to</em></td></tr>
<tr><td>
Network Connection
Network label:
CIS Lab Network</td><td>
Network connection
○ Bridged: Connected directly to the physical network
□ Replicate physical network connection state
○ NAT: Used to share the host's IP address
○ Host-only: A private network shared with the host
● Custom: Specific virtual network
VMnet3</td></tr>
</table>

top

Interfaces	
ifconfig or **/sbin/ifconfig**	Show the interface configurations. The full absolute pathname may be required if user is not logged in as root and /sbin is not in the user's path. **Example:** **/sbin/ifconfig**
ifconfig eth*n* (where *n* is the interface number)	Show settings for selected interface. **Example:** **ifconfig eth1** will show information on the eth1 interface.
ifconfig eth*n* down (where *n* is the interface number)	Bring an interface down **Example:** **ifconfig eth1 down** will disable the eth1 interface.
ifconfig eth*n* up (where *n* is the interface number)	Bring an interface up **Example:** **ifconfig eth1 up** will enable the eth1 interface.

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Interfaces - obtain dynamic IP address (temporary)	
dhclient -v eth*n*	Obtain an IP address for an interface from a DHCP server. **Example:** **dhclient -v eth0**
dhclient -r -v eth*n*	Release an IP address back to the DHCP server. **Example:** **dhclient -v -r eth0**

top

Interfaces - configure static IP configuration (temporary)	
ifconfig eth*n xxx.xxx.xxx.xxx***/***pp* *n* = interface number *xxx.xxx.xxx.xxx* = IP address *pp* = the slash network prefix To temporarily disable NetworkManager on Ubuntu use: **service network-manager stop**	Configure an interface with an IP address and subnet mask. **Example:** **ifconfig eth0 172.30.4.149/24**
ifconfig eth*n:m xxx.xxx.xxx.xxx***/***pp* *n* = interface number m=IP alias (sub-interface) number *xxx.xxx.xxx.xxx* = IP address *pp* = the slash network prefix	Configure an IP alias address and subnet mask. **Example:** **ifconfig eth0:1 172.30.4.150/24**
ifconfig eth*n xxx.xxx.xxx.xxx* **netmask** *nnn.nnn.nnn.nnn* *n* = interface number *xxx.xxx.xxx.xxx* = IP address *nnn.nnn.nnn.nnn* = subnet mask	Configure an interface with an IP address and subnet mask. **Example:** **ifconfig eth0 172.30.4.149 netmask 255.255.255.0** *(all on one line)* Equivalent to: **ifconfig eth0 172.30.4.149/24**
ifconfig eth*n xxx.xxx.xxx.xxx* **netmask** *nnn.nnn.nnn.nnn* **broadcast** *bbb.bbb.bbb.bbb* *(all on one line)* *n* = interface number *xxx.xxx.xxx.xxx* = IP address *nnn.nnn.nnn.nnn* = subnet mask bbb.bbb.bbb.bbb = broadcast address	Use this form of the command on older RH9 systems to prevent unintended settings based on the class of the network. **Example:** **ifconfig eth0 172.30.4.149 netmask 255.255.255.0 broadcast 172.30.4.255** *(all on one line)* Would configure eth0 with that IP address, mask and broadcast address.
ip address flush dev eth*n* *n* = interface number	Removes all settings from the selected interface. **Example:** **ip address flush dev eth0** will remove all interface settings, including the IP address, from eth0.

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Interfaces - permanent configuration (Red Hat family)

Edit **/etc/sysconfig/network-scripts/ifcfg-eth*n***
and add or modify these lines:

NM_CONTROLLED="*xx*"
ONBOOT="*xx*"
BOOTPROTO="*xx*"
IPADDR= *xxx.xxx.xxx.xxx*
NETMASK= *xxx.xxx.xxx.xxx*

These files are used at system startup to configure the interfaces.

Set NM_CONTROLLED to “yes” or “no” to use or not use Red Hat NetworkManager utility. Since we don’t use this in CIS192 set to “no”.

Set ONBOOT to “yes” to bring up the interface or “no” to disable the interface at system startup.

Set BOOTPROTO to “static” to configure a static IP address or “dhcp” to configure a dynamic IP address.

For static IP addresses, set IPADDR to the static IP address. Be sure this is a unique IP address for your system to avoid duplicate IPs on the network! Set NETMASK to the subnet mask.

For the new interface settings to take effect without restarting the system, use:
service network restart
or **/etc/init.d/network restart**

Each interface has an associated **ifcfg-eth*n*** file in the **/etc/sysconfig/network-scripts** directory.

Example: eth0 not configured
/etc/sysconfig/network-scripts/ifcfg-eth0
DEVICE="eth0"
NM_CONTROLLED="yes"
ONBOOT="no"

Example: eth0 has static IP
/etc/sysconfig/network-scripts/ifcfg-eth0
DEVICE="eth0"
NM_CONTROLLED="no"
ONBOOT="yes"
BOOTPROTO=”static”
IPADDR=172.30.4.149
NETMASK=255.255.255.0

Example: eth0 is DHCP
/etc/sysconfig/network-scripts/ifcfg-eth0
DEVICE="eth0"
NM_CONTROLLED="no"
ONBOOT="yes"
BOOTPROTO=”dhcp”

Example: IP alias on eth0
/etc/sysconfig/network-scripts/ifcfg-eth0:1
DEVICE="eth0:1"
NM_CONTROLLED="no"
ONBOOT="yes"
BOOTPROTO=”static”
IPADDR=172.30.4.224
NETMASK=255.255.255.0

top

Routing table configuration (temporary)	
route add default gw *xxx.xxx.xxx.xxx*	Adds the default gateway to the routing table. Unless there is another more specific route in the routing table this is the route will be used to send outbound packets. **Example:** **route add default gw 172.30.4.1** adds the lab router as the default gateway.
route del default gw *xxx.xxx.xxx.xxx*	Deletes the default gateway in the routing table. **Example:** **route del default gw 172.30.4.1** deletes the lab router as the default gateway.
route add -net *xxx.xxx.xxx.xxx/pp* **gw** *xxx.xxx.xxx.xxx*	Add static route **Example:** **route add -net 192.168.20.0/22 gw 172.30.4.250** *(all on one line)*
route del -net *xxx.xxx.xxx.xxx/pp* **gw** *xxx.xxx.xxx.xxx*	Delete static route

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Show and control routing	
route -n or **ip route show**	Show the current routing table. The -n (numerical) option makes it faster. This option disables DNS lookups to replace IP addresses with hostnames in the output.
route -C	Show the routing table cache
ip route flush cache	Flush the routing table cache

top

NetworkManager	
Fedora 17 **systemctl** *command* **NetworkMananger.service** where command = **enable, disable, stop, start, restart, status** or **service NetworkManager** *command* where command = **stop, start, restart, status** **chkconfig NetworkManager** *value* where value=**on**, **off**	NetworkManager should be disabled to manually configure NICs.
Ubuntu 12 **service network-manager** *command* where command = **stop, start, restart, status** To stop it from ever running again, edit the: **/etc/init/network-manager.conf** upstart script and comment out the “start on …” line	NetworkManager should be disabled to manually configure NICs.

top

Routing table permanent configuration (Red Hat family)	
Edit **/etc/sysconfig/network** with: **GATEWAY=** *xxx.xxx.xxx.xxx*	Edit this file to add a permanent default gateway to the routing table. The new settings do not take effect until the system or network service is restarted. **Example:** **/etc/sysconfig/network** **NETWORKING=yes** **HOSTNAME=elrond.localdomain** **GATEWAY=172.30.4.1** The default gateway on Elrond has been set to the CIS Lab router (172.30.4.1). For the new interface settings to take effect without restarting the system, use: **service network restart** or **/etc/init.d/network restart**
Edit **/etc/sysconfig/network-scripts/route-eth***n* with: *xxx.xxx.xxx.xxx/pp* **via** *xxx.xxx.xxx.xxx*	Add static route permanently **Example:** **/etc/sysconfig/network-scripts/route-eth0** **192.168.20.0/22 via 172.30.4.250** to route traffic to the 192.168.20.0/22 network out the eth0 interface to the 172.30.4.250 “next hop” gateway router.

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Hostname configuration	
redhat 1) Edit **/etc/sysconfig/network:** **HOSTNAME=** *hostname* 2) Edit **/etc/hosts** to insure the same hostname is used there.	Edit this file to name the system. **Example:** **/etc/sysconfig/network** **NETWORKING=yes** **HOSTNAME=elrond.localdomain** **GATEWAY=172.30.4.1** Restart the system for the new hostname to take full effect.
debian 1) Edit **/etc/hostname:** *hostname* 2) Edit **/etc/hosts** to insure the same hostname is used there.	Edit this file to name the system. **Example:** **/etc/hostname** **frodo** Restart the system for the new hostname to take full effect.

top

Network configuration - Debian family (permanent)	
Edit **/etc/network/interfaces** Use this "deprecated" script to restart network services: **/etc/init.d/networking restart** It seems this script in now deprecated and each interface must be manually shut down then brought back up! See: http://bugs.debian.org/cgi-bin/bugreport.cgi?bug=565187	Edit this file to permanently configure networking on Debian and Ubuntu systems. **Example: DHCP** **/etc/network/interfaces** auto lo iface lo inet loopback auto eth0 iface eth0 inet dhcp **Example: static IP** **/etc/network/interfaces** auto lo iface lo inet loopback auto eth0 iface eth0 inet static address 172.30.4.222 netmask 255.255.255.0 gateway 172.30.4.1 dns-search cislab.net dns-nameservers 172.30.5.8 10.240.1.2 **Example: IP alias** **/etc/network/interfaces** auto lo iface lo inet loopback auto eth0 iface eth0 inet static address 172.30.4.222 netmask 255.255.255.0 auto eth0:1 iface eth0:1 inet static address 172.30.4.223 netmask 255.255.255.0 gateway 172.30.4.1 **Example: static IP and routes** **/etc/network/interfaces** auto lo
Watch out for Network Manager For non-mobile systems with static IP address disable Network Manager: To temporarily disable NetworkManager on Ubuntu use: **service network-manager stop** To stop it from ever running again, edit the: **/etc/init/network-manager.conf** upstart script and comment out the "start on ..." line(s)	

	iface lo inet loopback auto eth0 iface eth0 inet static address 172.30.4.222 netmask 255.255.255.0 gateway 172.30.4.1 up route add -net 192.168.2.0/24 gw 172.30.4.107 *(all on one line)* up route add -net 192.168.3.0/24 gw 172.30.4.107 *(all on one line)* **Example: static IP, routes and DNS** **/etc/network/interfaces** auto lo iface lo inet loopback auto eth0 iface eth0 inet static address 172.30.4.222 netmask 255.255.255.0 gateway 172.30.4.1 up route add -net 192.168.2.0/24 gw 172.30.4.107 *(all on one line)* up route add -net 192.168.3.0/24 gw 172.30.4.107 *(all on one line)* dns-search cislab.net dns-nameservers 172.30.5.8 10.240.1.2

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Name resolution	
On Red Hat family and some Debian family: The **/etc/resolv.conf** file: **search** *domain* **nameserver** *<ip address>*	Edit this file to specify one or more DNS server. The first server listed will be the primary name server. The second will be the secondary name server and so forth. **Example:** **/etc/resolv.conf** **search cislab.net** **nameserver 172.30.5.8** **nameserver 10.240.1.2** configures the CIS VLab DNS server (172.30.5.8) as the primary and the campus DNS server (10.240.1.2) as the secondary. Allows users to use shortnames for the cislab.net domain. For example **ping opus** will be treated as if the user typed **ping opus.cislab.net.**
On Debian family: Check to see if **/etc/resolv.conf** is symbolically linked to **../run/resolvconf/resolv.conf** and if it is DO NOT MODIFY **/etc/resolv.conf**. Instead add the equivalent lines to the **/etc/network/interfaces** file: **dns-search** *domain* **dns-nameservers** *<ip address> <ip address>* then restart networking service.	
> /etc/resolv.conf	Clears all DNS name servers
The **/etc/hosts** file: xxx.xxx.xxx.xxx name1 name2 …	Edit this file to locally add name resolution for commonly used hosts. Each line is this file starts with an IP address and is followed by one or more hostnames. **Example:** **echo " 192.168.23.200 sauron " >> /etc/hosts** *(all on one line)* allows you to ping sauron by name in addition to by IP address.

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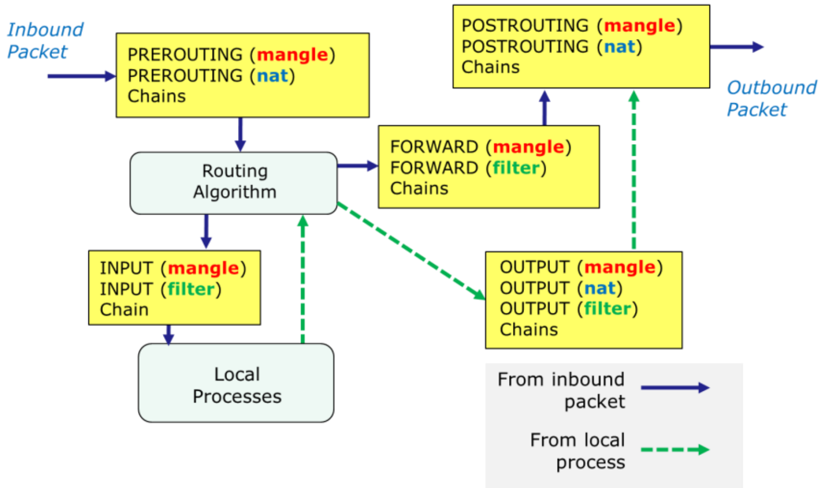
Packet forwarding	
echo 1 > /proc/sys/net/ipv4/ip_forward	Temporarily enable packet forwarding
echo 0 > /proc/sys/net/ipv4/ip_forward	Temporarily disable packet forwarding
cat /proc/sys/net/ipv4/ip_forward	Show packet forwarding status 0 = off (disabled) 1 = on (enabled)
The **/etc/sysctl.conf** file **net.ipv4.ip_forward =** *n* use *n*=0 to disable, use *n*=1 to enable For the new settings to take effect without restarting the system, use: **sysctl -p**	To permanently enable or disable packet forwarding. **Example:** **/etc/sysctl.conf** <snipped> **net.ipv4.ip_forward = 1** <snipped> will enable packet forwarding during system start or when the network service is restarted.

top

Firewalls	
Netfilter – all tables and chains  Inbound Packet PREROUTING (mangle) PREROUTING (nat) Chains POSTROUTING (mangle) POSTROUTING (nat) Chains Outbound Packet Routing Algorithm FORWARD (mangle) FORWARD (filter) Chains INPUT (mangle) INPUT (filter) Chain OUTPUT (mangle) OUTPUT (nat) OUTPUT (filter) Chains Local Processes From inbound packet From local process	
iptables -L	Show the current firewall rules.
iptables -nL	Show the current firewall in numerical form, e.g. the ssh port shows as 22 instead of ssh.
iptables -nL --line-numbers	Same as above but shows line numbers.
iptables -F	Disables the firewall by flushing (deleting) all rules on all chains in memory.
iptables -D *chain rulenum*	Delete a rule on a chain in memory. **Example:** **iptables -D FORWARD 1** Delete the first rule on the FORWARD chain. This will modify the default CentOS firewall to allow packet forwarding.
iptables -P *chain target*	Set the policy on a chain to a target (e.g. ACCEPT, REJECT, DROP, etc) for the packet, if no rules apply. **Example:** **iptables -P FORWARD ACCEPT** sets the policy on the FORWARD chain to accept the packet, if no rules have applied.
service iptables restart	Loads the firewall rules from the

	/etc/sysconfig/iptables
service iptables save	Make the current firewall rules in memory permanent. The rules are saved in the /etc/sysconfig/iptables file.
iptables-save > iptables.bak	Copy the current firewall rules in memory to a file. Note: This may fail now due to SELinux (see /var/log/messages to verify). A partial workaround is to use: **service iptables save** but as this clobbers /etc/sysconfig/iptables be sure to back it up first.
iptables-restore < iptables.bak	Restore the current firewall in memory from a file.
iptables -A FORWARD -j REJECT --reject-with icmp-host-prohibited	Adds default CentOS rule for FORWARD chain. This will block packet forwarding.

top

Firewalls (Red Hat Family)	
Firewall configuration file: **/etc/sysconfig/iptables**	This file is not intended to be directly edited. You can copy this file to back it up. The contents are useful as they show how to form the actual iptables commands that could be entered from the command line **Example:** **cd /etc/sysconfig** **cp iptables iptables.bak** will backup the current firewall configuration file. **Example:** **cd /etc/sysconfig** **cp iptables.bak iptables** will restore the current firewall configuration file from the backup file. **Example:** **service iptables save** will replace /etc/sysconfig/iptables file with the current rules in memory. **Example:** **service iptables restart** loads the firewall rules into memory from /etc/sysconfig/iptables.

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NAT Favorites

Example:

```
iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
```

Adds NAT to a gateway router whose eth0 interface is on the public side

Example:

```
iptables -t nat -A POSTROUTING -o eth0 -j SNAT --to-source < ip address on eth0 >
```

Adds NAT to a gateway router whose eth0 interface is on the public side

Example:

```
iptables -t nat -A PREROUTING -i eth0 -p tcp -m tcp --dport  <port>  -j DNAT --to-destination < ip address of server >
```

Adds port forwarding to a gateway router whose eth0 interface is on the public side to redirect incoming traffic, based on the port, to the appropriate internal server.

Common ports:
21 = ftp
22= ssh
23 = telnet
80 = http
3389 = remote desktop protocol

top

Firewall Brute Force Blocker

Example:

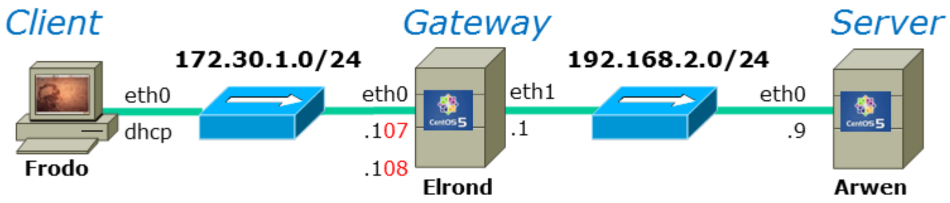
```
[rsimms@opus ~]$ cat /etc/sysconfig/iptables
< snipped >
# Impede brute force SSH dictionary attacks using the recent module (Rule added by RJS)
-A RH-Firewall-1-INPUT -p tcp --dport 22 -m state --state NEW -m recent --set –name SHBF
-A RH-Firewall-1-INPUT -p tcp --dport 22 -m state --state NEW -m recent --update --seconds 60 --hitcount 4 --rttl --name SSHBF -j LOG --log-level info --log-prefix "iptables brute force block: "
-A RH-Firewall-1-INPUT -p tcp --dport 22 -m state --state NEW -m recent --update --seconds 60 --hitcount 4 --rttl --name SSHBF -j DROP
< snipped >
```

Credit: http://kevin.vanzonneveld.net/techblog/article/block_brute_force_attacks_with_iptables/

top

Firewall - Lab 5

Example:

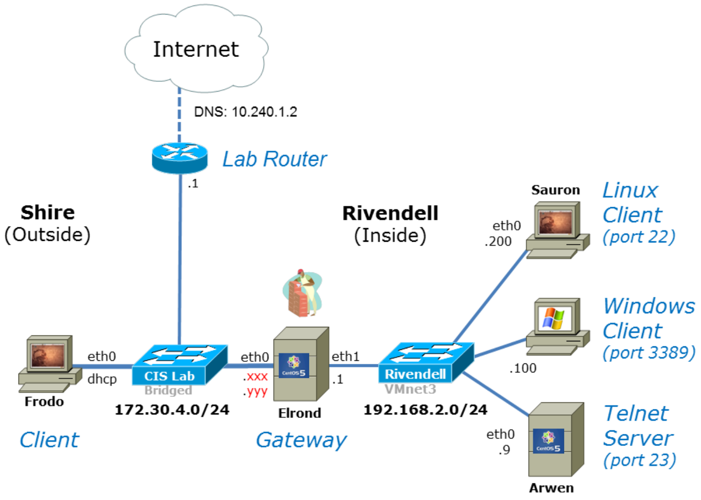


```
iptables -P INPUT DROP
iptables -P FORWARD DROP
iptables -P OUTPUT DROP
iptables -A FORWARD -s 192.168.2.0/24 -d 0/0 -m state --state NEW -j ACCEPT
iptables -A FORWARD -s 0/0 -d 192.168.2.9 -m state --state NEW -p tcp --dport 23 -j ACCEPT
iptables -A FORWARD -m state --state ESTABLISHED,RELATED -j ACCEPT
iptables -A OUTPUT -m state --state NEW,ESTABLISHED,RELATED -j ACCEPT
iptables -A INPUT -i eth1 -s 192.168.2.0/24 -d 192.168.2.1 -m state --state NEW -j ACCEPT
iptables -A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT
ifconfig eth0:1 172.30.1.108 netmask 255.255.255.0 broadcast 172.30.1.255
iptables -t nat -A PREROUTING -i eth0 -d 172.30.1.108 -j DNAT --to-destination 192.168.2.9
iptables -t nat -A POSTROUTING -o eth0 -s 192.168.2.9 -j SNAT --to-source 172.30.1.108
iptables -t nat -A POSTROUTING -o eth0 -s 192.168.2.0/24 -j SNAT --to-source 172.30.1.107
iptables -A INPUT -j LOG --log-level info --log-prefix "iptables INPUT: "
iptables -A FORWARD -j LOG --log-level info --log-prefix "iptables FORWARD: "
```

top

NAT - Port forwarding

Example:



```
 [root@elrond sysconfig]# cat iptables
# Generated by iptables-save v1.4.7 on Sat Nov 19 08:25:01 2011
*nat
:PREROUTING ACCEPT [1216:196031]
:POSTROUTING ACCEPT [8:510]
:OUTPUT ACCEPT [3:210]
# Redirect incoming public IP traffic based on destination port
-A PREROUTING -d 172.30.4.253/32 -p tcp -m tcp --dport 22 -j DNAT --to-destination 192.168.2.200
-A PREROUTING -d 172.30.4.253/32 -p tcp -m tcp --dport 23 -j DNAT --to-destination 192.168.2.9
-A PREROUTING -d 172.30.4.253/32 -p tcp -m tcp --dport 3389 -j DNAT --to-destination 192.168.2.100
# Internet for Rivendell hosts using NAT
-A POSTROUTING -s 192.168.2.9/32 -o eth0 -j SNAT --to-source 172.30.4.253
-A POSTROUTING -s 192.168.2.0/24 -o eth0 -j SNAT --to-source 172.30.4.252
COMMIT
# Completed on Sat Nov 19 08:25:01 2011
# Generated by iptables-save v1.4.7 on Sat Nov 19 08:25:01 2011
*filter
:INPUT DROP [894:156935]
:FORWARD DROP [7:668]
:OUTPUT DROP [0:0]
-A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT
-A INPUT -s 192.168.2.0/24 -d 192.168.2.1/32 -i eth1 -m state --state NEW -j ACCEPT
-A INPUT -j LOG --log-prefix "iptables INPUT:" --log-level 6
-A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT
-A FORWARD -s 192.168.2.0/24 -m state --state NEW -j ACCEPT
-A FORWARD -d 192.168.2.200/32 -p tcp -m state --state NEW -m tcp --dport 22 -j ACCEPT
-A FORWARD -d 192.168.2.9/32 -p tcp -m state --state NEW -m tcp --dport 23 -j ACCEPT
-A FORWARD -d 192.168.2.100/32 -p tcp -m state --state NEW -m tcp --dport 3389 -j ACCEPT
-A FORWARD -j LOG --log-prefix "iptables FORWARD:" --log-level 6
-A OUTPUT -m state --state NEW,RELATED,ESTABLISHED -j ACCEPT
COMMIT
# Completed on Sat Nov 19 08:25:01 2011
```

top

SELinux	
getenforce	Determine the current mode of SELinux. **Example:** **getenforce** outputs permissive or enforcing
setenforce *n* where *n* = 0 for permissive or 1 for enforcing	Change the mode of SELinux. **Example:** **setenforce 0** **getenforce** Permissive **Example:** **setenforce 1** **getenforce** Enforcing
ls -Z *pathname*	The Z option on the ls command shows the SELinux context for a file or files **Example:** **ls -lZ /var/ftp/pub** will show a long listing and SELinux context information of the anonymous FTP directory
chcon -R -v -t *pathname* *where:* *-R is used to apply recursively to subdirectories* *-v is verbose to indicates what was changed* *-t is SELinux context type*	Change the SELinux context for a file or files **Example:** **chcon -R -v -t public_content_t /var/ftp** will set the default context type on all the files in the anonymous FTP directory.
getsebool *variable*	Get the value of a SELinux Boolean variable **Example:** **getsebool ftp_home_dir**
getsebool -a	Get the value of all SELinux Boolean variables. **Example:** **getsebool -a | grep ftp**
setsebool *variable*	Set the value of a SELinux Boolean variable **Example:**

	setsebool -P ftp_homedir=1

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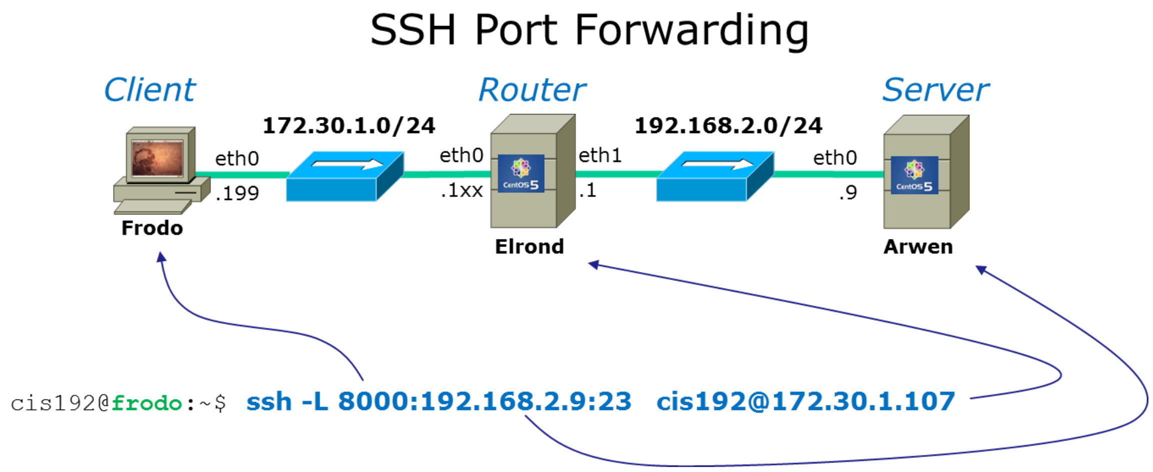
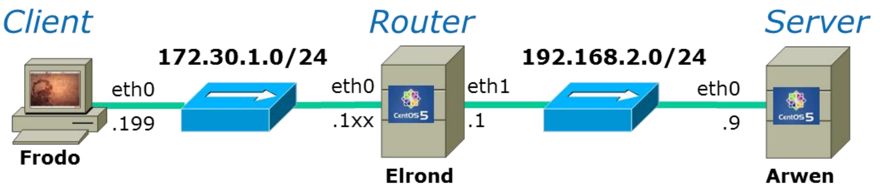
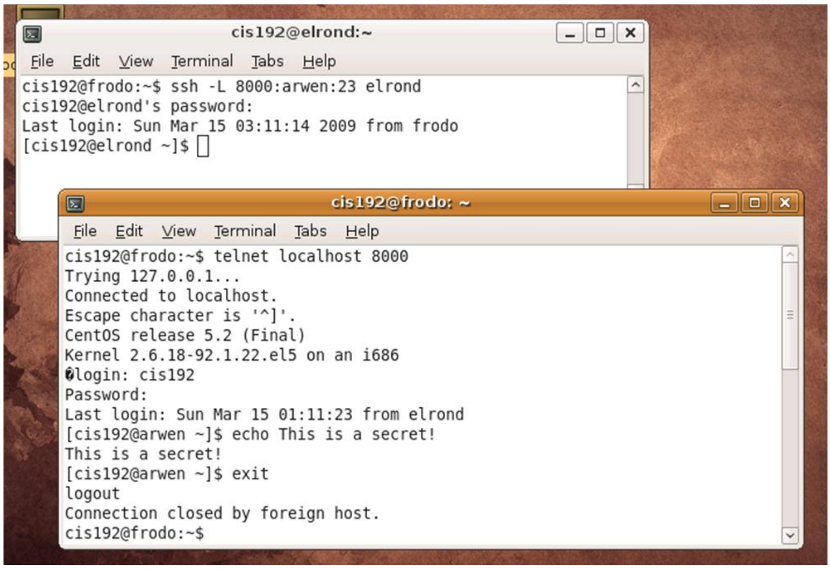
SSH Tunneling (Port Forwarding)



```
cis192@frodo:~$ ssh -L 8000:192.168.2.9:23  cis192@172.30.1.107
```

Any connection made to port 8000 on Frodo will get forwarded to port 23 on Arwen via Elrond. The portion of the connection between Frodo and Elrond will be encrypted




cis192@elrond:~
File Edit View Terminal Tabs Help

```
cis192@frodo:~$ ssh -L 8000:arwen:23 elrond
cis192@elrond's password:
Last login: Sun Mar 15 03:11:14 2009 from frodo
[cis192@elrond ~]$ 
```

cis192@frodo: ~
File Edit View Terminal Tabs Help

```
cis192@frodo:~$ telnet localhost 8000
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
CentOS release 5.2 (Final)
Kernel 2.6.18-92.1.22.el5 on an i686
�login: cis192
Password:
Last login: Sun Mar 15 01:11:23 from elrond
[cis192@arwen ~]$ echo This is a secret!
This is a secret!
[cis192@arwen ~]$ exit
logout
Connection closed by foreign host.
cis192@frodo:~$
```

Requires one Frodo terminal to setup SSH port forwarding

And another Frodo terminal to make the Telnet connection

top

10 Steps for Installing Network Services

1. Install software package using **yum**, **rpm, apt-get** or build from source code
2. Customize service's configuration file
3. Modify the firewall to allow access to the service
4. Customize SELinux context settings to allow use
5. Start the service
6. Configure service to automatically start when system boots
7. Monitor and verify service is running
8. Troubleshoot as necessary
9. Monitor log files as appropriate
10. Configure additional security

top

FTP Service

Ports: **21/TCP** (commands) and **20/TCP** (data)

Server Package: **vsftpd**

Configuration file: **/etc/vsftpd/vsftpd.conf**

Firewall examples:

```
iptables -I INPUT n -m state --state RELATED,ESTABLISHED -j ACCEPT
iptables -I INPUT n  -p tcp -m state --state NEW -m tcp --dport 21 -j ACCEPT
```

Firewall helper modules:

```
modprobe nf_conntrack_ftp
modprobe nf_nat_ftp
```

(or add these modules permanently to **/etc/sysconfig/iptables-config**)

SELinux:
To allow users to FTP to there home directories:

```
getsebool  ftp_home_dir
setsebool  -P  ftp_home_dir=1
```

Service control:

```
service vsftpd  start
service vsftpd  stop
service vsftpd  restart
service vsftpd  status

chkconfig  vsftpd  on
chkconfig  vsftpd  off
```

TCP wrapper examples:

/etc/hosts.all

```
vsvtpd:  192.168.2.0/24 Frodo
```

/etc/hosts.deny

```
ALL: ALL
```

Anonymous file location: **/var/ftp/pub**

Client package: vsftp

Client usage: **ftp** *IP_address*

Wireshark filter examples: ftp, ip-host == 172.30.4.240

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Telnet Service

Ports: **23/TCP**

Telnet Service

Package: **telnet-server**
Configuration file: **/etc/xinetd.d/telnet**

```
[root@elrond ~]# cat /etc/xinetd.d/telnet
# default: on
# description: The telnet server serves telnet sessions; it uses \
#       unencrypted username/password pairs for authentication.
service telnet
{
        flags           = REUSE
        socket_type     = stream
        wait            = no
        user            = root
        server          = /usr/sbin/in.telnetd
        log_on_failure  += USERID
        disable         = no
}
```

Firewall examples:
iptables -I INPUT n -m state --state RELATED,ESTABLISHED -j ACCEPT
iptables -I INPUT n -p tcp -m state --state NEW -m tcp --dport 23 -j ACCEPT

Firewall helper modules:
na

SELinux:
na

Service control:
chkconfig xinetd on
chkconfig xinetd off

service xinetd start
service xinetd stop
service xinetd restart
service xinetd status

TCP wrapper examples:
/etc/hosts.all
in.telnetd: 192.168.2.0/24   Frodo

/etc/hosts.deny

```
ALL: ALL
```

Telnet Client

package: **telnet**

Usage: **telnet** *IP_address [port]*

Wireshark filter: tcp.port == 23 and ip.addr == *xxx.xxx.xxx.xxx*

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Connectivity Testing	
ping *hostname* **ping** *xxx.xxx.xxx.xxx*	Test connectivity with another computer on the network. Use **Ctrl-C** to stop pinging. Options: **-c** *num* (limit the number of pings) -R (shows route travelled) -b (broadcast ping) **Example:** **ping -c3 google.com** will ping Google three times then stop. **Example:** **ping -Rc3 172.30.4.150** will show the route and do three pings. **Example:** **ping -b 172.30.4.255** will do a broadcast ping on the 172.30.4.0/24 network.
echo 0 > /proc/sys/net/ipv4/icmp_echo_ignore_broadcasts *(all on one line)*	Enables Linux system to respond to broadcast pings.
ping6 -I eth*n IPv6-address*	Works like the IPv4 ping except the outgoing interface must be specified. **Example:** **ping6 -I eth0 fe80::20c:29ff:fe2a:5717**
mtr *hostname* **or mtr** *xxx.xxx.xxx.xxx* Use q to quit	Displays the full route to the host and will refresh travels times.
traceroute *hostname* **or traceroute** *xxx.xxx.xxx.xxx* Use q to quit	Displays the full route to the host and will refresh travels times. Options: -I (use ICMP to get past some firewalls) **Example:** **traceroute google.com** **Example:** **traceroute -I opus.cabrillo.edu**

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Packet Sniffing	
tcpdump Use **-n** to prevent DNS lookups Use **Ctrl-s** or **Ctrl-q** to stop and continue Use **Ctrl-c** to quit	Will start sniffing packets. http://www.alexonlinux.com/tcpdump-for-dummies http://danielmiessler.com/study/tcpdump/
tcpdump -n arp or icmp	Packet sniffing command to capture only arp and icmp packets
tcpdump –n host *xxx.xxx.xxx.xxx* **and** *protocol* where protocol = **icmp, tcp, ip,** etc.	Capture only packets coming from or going to a host with a specific protocol **Example:** **tcpdump –n host 192.168.2.200 and icmp** *(all on one line)*
tcpdump -n host *xxx.xxx.xxx.xxx* **and host** *xxx.xxx.xxx.xxx* *(all on one line)*	Packet sniffing command to capture only traffic between two hosts. **Example:** **tcpdump -n host 172.30.4.25 and host 172.30.4.1** *(all on one line)*
tcpdump -ne -i eth*n* **port** *nn* **or port** *nn*	**Example:** **tcpdump -ne -i eth1 port 80 or port 22** • no DNS lookups (-n) • shows mac addresses (-e) • will listen on eth1 interface (-i eth1) • only captures ssh and http traffic (port 80 or 22)

[top](#top)

ARP commands	
arp -n	Display arp cache
ip neigh flush all	Flush arp cache
arpwatch (Red Hat family) Install arpwatch if necessary: • rpm –qa | grep arpwatch • yum install arpwatch Install /bin/mail if necessary: • rpm –qa | grep mailx • yum install mailx **service arpwatch start** *<Collection runs in the background>* **service arpwatch restart** **cat /var/lib/arpwatch/arp.dat**	arwatch (Debian family) Install arpwatch if necessary: • dpkg –l | grep arpwatch • apt-get install arpwatch Install /bin/mail if necessary: • dpkg –l | grep sendmail • apt-get install sendmail • dpkg –l | grep heirloom-mail • apt-get install heirloom-mail **/etc/init.d/arpwatch start** *<Collection runs in the background>* **/etc/init.d/arpwatch restart** **cat /var/lib/arpwatch/arp.dat**

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Linux hardware and driver commands	
lspci or **/sbin/lspci**	Shows PCI devices including what NIC or NICs (Network Interface Controllers) are being used to physically connect the system to the network. The full absolute pathname may be required if user is not logged in as root and /sbin is not in the user's path. **Example:** **lspci | grep -i ether** will show all the ethernet NICs on the system.
lspci -k	Show the drivers kernel modules used by the PCI devices including any NICs. **Example:** **lspci -k | grep -iA4 ether** will show the drivers used by the NICs on your system.
lsmod or **/sbin/lsmod**	Shows the kernel modules that are currently loaded. Example NIC drivers (implemented as kernel modules) are e100 (Intel), e1000 (Intel), pcnet32 (AMD) and vmxnet (VMware). The full absolute pathname may be required if user is not logged in as root and /sbin is not in the user's path.
rmmod *module*	Use to unload (remove) a running kernel module (e.g. a NIC driver). **Example:** **rmmod e1000** would unload the Intel gigabit NIC driver if it was loaded.
modprobe *module*	Use to load a kernel module (e.g. NIC driver). **Example:** **modprobe e1000** would load the Intel gigabit NIC driver if not loaded already.
ls /lib/modules/$(uname -r)/kernel/drivers/net/	List all NIC drivers. These drivers are implemented as kernel modules and have a .ko suffix

	Information on older NIC drivers can be found here: http://www.tldp.org/HOWTO/text/Ethernet-HOWTO **Example:** **ls /lib/modules/2.6.32-71.el6.i686/kernel/drivers/net/** *(all on one line)* will list all the network drivers on the CentOS VMs used in the Fall 2011 term.

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General Linux commands - root and shutting down	
su -	To become root (superuser). The “-“ is very important as it provides root’s shell environment.
sudo -i or **sudo su -**	To become root on the Ubuntu VMs.
exit	End a terminal login session
init 0 or **shutdown** *options time warning*	init 0 is a fast way to gracefully shutdown a VM. Note: no warning is given to users that the system will be shut down. The shutdown command is much more friendly in that it warns users before shutting down in the specified time interval. **Example:** **shutdown -h +5 ‘Save your work!’** Tells all users the system will shut down in 5 minutes and warns then to save their work. The h option performs a halt after the shutdown.

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General Linux commands - basic inventory	
hostname	Shows the hostname of the system being used.
tty	Shows the current terminal being used.
uname -r	Print the version of the kernel being used.
who	Show logged in users and the IP address or hostnames they logged in from.
echo $PATH	Shows your path. The shell uses the path to locate any commands entered. Entering a command that is not located on the path will result in a “command not found” error.
cat /etc/*-release	Shows the name of the Linux distribution being run.

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General Linux commands - files	
ls *[pathname]*	Short listing of files in current directory or pathname if specified.
ls -l *[pathname]*	Short listing of files in current directory or pathname if specified.
cat *pathname* **head** *pathname* **tail** *pathname* **more** *pathname* **less** *pathname*	Commands to display text files.
tail -f /var/log/messages	Useful for monitoring log files in real time.
vi *pathname*	Run the vi text editor on the specified file. **Example:** **vi lab01**
General Linux commands - redirection	
> *filename*	*filename* is created if it does not exist and emptied. **Example:** **> output** would empty the file named output or create it if it did not exist already.
command **>** *filename*	*filename* is emptied, then the output of the command is redirected into *filename.* **Example:** **ifconfig > output** would save the output of the ifconfig command in a file named output.
command **>>** *filename*	Output of the command is appended to the end of *filename.* **Example:** **route -n >> output** would append the routing table to the end of the file named output.

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General Linux commands - logging in to a remote system	
ssh *account***@***hostname* **ssh** *account***@***xxx.xxx.xxx.xxx*	Login to a remote Linux computer on the network. **Example:** **ssh cis192@172.30.4.153**
ssh *account***@***hostname* **'***command***'**	Run a command on a remote system. Example: **ssh root@172.30.4.164 'ifconfig'** would run the ifconfig command on the remote system and show the output of the command on the local system.
ssh *account***@***IPv6address***%eth***n*	**ssh** works with IPv6 addresses too but the outgoing interface being specified. **ssh cis192@fe80::20c:29ff:fe2a:5717&eth0** *(all on one line)*
General Linux commands - copying files	
cp *source destination*	Linux command to copy file(s) from the source pathname to the destination pathname. **Example:** **cp /home/cis192/depot/lab01 .** will copy the file named lab01 in the /home/cis192/depot directory to your current directory.
scp *pathname account***@***host***:***pathname* **scp** *account***@***host***:***pathname pathname*	Copy files from one system to another. **Example:** **scp output simben192@opus.cabrillo.edu:** (above all on one line) would copy the local file named output to the user simben192's home directory on Opus.

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General Linux commands - installing more commands or other software	
redhat **yum install** *package* **yum remove** *package* **yum provides** *command* **rpm -qa | grep** *package*	**Examples:** **rpm -qa | grep vsftpd** will check if vsftpd is installed **Examples:** **yum install traceroute** **yum install mtr tcpdump mailx** will install those packages **Example:** **yum remove traceroute** will remove the traceroute package **Example:** **yum provides mail** will find the name of the package to install for the mail command.
debian **apt-get install** *package* **apt-get remove** *package* **apt-get update** **dpkg -l | grep package**	**Examples:** **apt-get install traceroute** **apt-get install mtr tcpdump** **apt-get install wireshark ipcalc** **Examples:** **apt-get remove wireshark** will remove wireshark **Examples:** **dpkg -l | grep wireshark** will show if wireshark is installed **Examples:** **apt-get update** will update the servers used to download packages
General Linux commands - useful scripts	
while true; do *command*; **sleep** *seconds*; **done**	Repeatedly issue the same command over and over. **Example:** **while true; do ping sauron -c1; sleep 30; done** will ping sauron once every 30 seeonds

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VMware commands and operations	
Change virtual terminals On PC Keyboard: • Method 1: While holding down the **Ctrl-Alt** keys, tap **spacebar** then tap f1, f2, ... or f7. • Method 2: While holding down **Alt** key, tap f1, f2, ... or f7. Does not always work but simpler than method 1. On Mac keyboard: • Hold down **Control** and **Option** keys, tap the **spacebar**, hold down **fn** key (in addition to **Control** and **Option** keys) and tap f1, f2, ... or f7.	Change to a different virtual terminal on the VM. F7 is graphics mode for the Ubuntu VMs. The Centos VMs do not have graphics mode (init level 3 only) Note: the spacebar does not need to be tapped on a physical (non-VM) system. This is just required for changing virtual terminals on VMware VMs.
Copy/Paste (vSphere Client) To enable this option for a specific virtual machine: 1. Log into a vCenter Server system using the vSphere Client and power off the virtual machine. 2. Select the virtual machine and click the **Summary** tab. 3. Click **Edit Settings**. 4. Navigate to **Options** > **Advanced** > **General** and click **Configuration Parameters**. 5. Click **Add Row**. 6. Type these values in the Name and Value columns: ○ isolation.tools.copy.disable – false ○ isolation.tools.paste.disable – false **Note**: These options override any settings made in the VMware Tools control panel of the guest operating system. 7. Click **OK** to close the Configuration Parameters dialog, and click **OK** again to close the Virtual Machine Properties dialog. **8.** Power on the virtual machine.	**Copy/Paste (**ESXi server) To enable this option for all the virtual machines in the ESX/ESXi host: 1. Log in to the ESX/ESXi host as a root user and open the /etc/vmware/config file using a text editor. 2. Add these entries to the file: isolation.tools.copy.disable="FALSE" isolation.tools.paste.disable="FALSE" Save and close the file. The Copy and Paste options are only enabled when the virtual machines restart or resume the next time.

<table>
<tr>
<td><b>Fix unintended repeated keystrokes</b>

To enable this option for a specific virtual machine:

1. Log into a vCenter Server system using the vSphere Client and power off the virtual machine.
2. Select the virtual machine and click the <b>Summary</b> tab.
3. Click <b>Edit Settings</b>.
4. Navigate to <b>Options</b> &gt; <b>Advanced</b> &gt; <b>General</b> and click <b>Configuration Parameters</b>.
5. Click <b>Add Row</b>.
6. Type these values in the Name and Value columns:

<table><tr><td>keyboard.typematicMinDelay</td><td>200000</td></tr></table>

7. Click <b>OK</b> to close the Configuration Parameters dialog, and click <b>OK</b> again to close the Virtual Machine Properties dialog.
8. Power on the virtual machine.</td>
<td><b>Fix unintended repeated keystrokes</b>

To enable this option for all the virtual machines in the ESXi host:

1. Log in to the ESXi host as a root user and open the <i>/etc/vmware/config</i> file using a text editor.
2. Add this entry to the file:

keyboard.typematicMinDelay = 200000

Save and close the file.</td>
</tr>
</table>

top