JUNIPER WORKBOOK

A JUNOS GUIDE BY AN IOS GUY

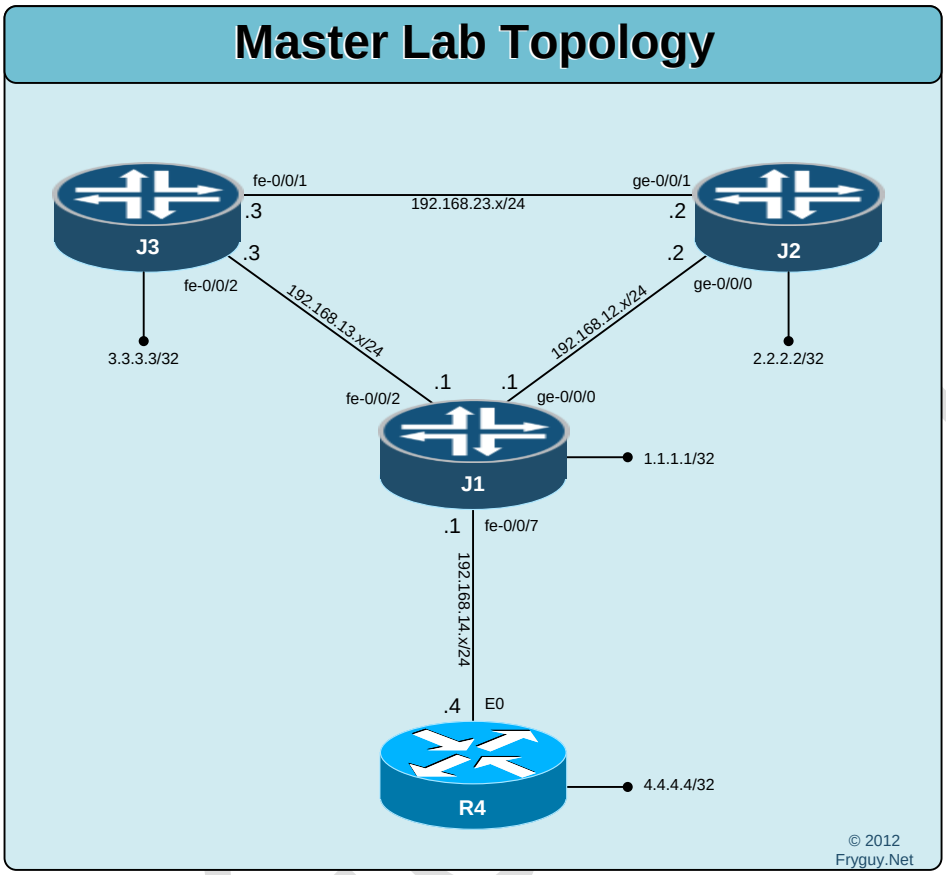
VOLUME 1

JEFFREY FRY

CCIE R&S 22061

WWW.FRYGUY.NET

The main topology and hardware layout is below:



Hardware Specs:

R4 – Cisco 831 running 12.4(25d)
E0 connected to J1 fe-0/0/7

J1 – Juniper SRX210 running JUNOS 12.1R2.9
fe-0/0/7 connected to R4 – E0
ge-0/0/0 connected to J2 – ge-0/0/0
fe-0/0/2 connected to J3 – fe-0/0/2

J2 – Juniper SRX210 running JUNOS 12.1R2.9
ge-0/0/0 connected to J1 – ge-0/0/0
ge-0/0/1 connected to J3 – fe-0/0/1

J3 – Juniper SRX100 running JUNOS 12.1R2.9
fe-0/0/1 connect to J2 – ge-0/0/1
fe-0/0/2 connected to J1 – fe-0/0/2

Items in **BLUE** are system output
Items in **RED** are entered commands
Items in **GREEN** are comments

Table of Contents

Preface

I just wanted to take a moment and explain what this "workbook" is and thank a few people for their help, guidance, and inspiration.

It is my intention for this "workbook" to help those of us who know Cisco IOS to learn and understand Juniper Junos. I will admit that I was initially intimidated by the look of the Junos configuration, but as time has gone on I have learned to understand it and actually like it. As they say, the more you work with something, the more comfortable you feel with it.

The way that I came up with this guide was by first drawing the scenarios I wanted to figure out. Take the things that I knew worked and how they worked in IOS and then figure out how they worked in Junos. This approach was not structured per-se, it was more – go at it and figure it out. There are technologies that I struggled with in Junos, but once I figured them out, they quickly become clear and easier to me.

I have sketches for some other ideas that I want to learn with Junos and I will work on these as time allows. Perhaps we will see additional "workbooks" released as I continue to learn more about Junos!

I wanted to thank Kurt, Steve, and Damien for their help with commands and their honest feedback while I was working on this document. I know I bombarded their inboxes with the drafts and questions; I really appreciate all the help gents! I also wanted to thank Chris Jones for helping me get some of the icons used in this document, he provided me a dirty template that I was able to modify and tweak to get things to look the way I wanted. And finally I want to thank my old Juniper SE, Matt McGuirl for introducing me to Junos.

You can find them at their websites below and on Twitter

Kurt Bales – http://www.network-janitor.net/ – @networkjanitor

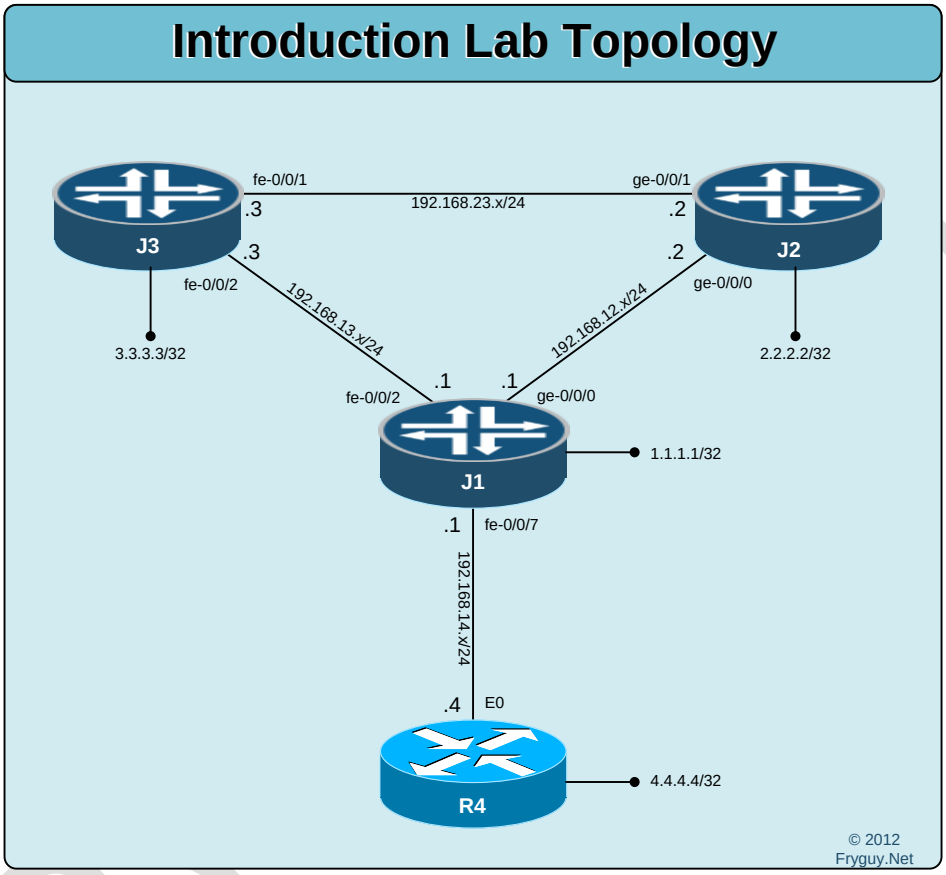
Steve Rossen – http://steverossen.com/ – @steve

Damien DeVille – http://www.damiendeville.com/ – @ddeville

Chris Jones – http://www.3fives.com/ – @ipv6freely

Matt McGuirl – http://www.mcguirl.net/ – @mcguirl

Password Recovery, Zeroize, and Loading a Configuration, and other basics



I am not going to cover how to recovery a lost root password, but if you need that information here is a link to the Juniper KB Article KB17565 below. This article is for Junos 10.x and higher.
http://kb.juniper.net/InfoCenter/index?page=content&id=KB17565

What I will cover though is getting your Junos device up and running after you recover the root password. First thing you will want to do is zeroize the device, this will erase all configuration information and reboot the device.

```
root@J1> request system zeroize
warning: System will be rebooted and may not boot without configuration
Erase all data, including configuration and log files? [yes,no] (no) yes

warning: zeroizing re0

root@J1> Waiting (max 60 seconds) for system process `vnlru_mem' to stop...done
```

```
Waiting (max 60 seconds) for system process `vnlru' to stop...done
Waiting (max 60 seconds) for system process `bufdaemon' to stop...done
Waiting (max 60 seconds) for system process `syncer' to stop...
Syncing disks, vnodes remaining...0 0 0 done

syncing disks... All buffers synced.
Uptime: 5m9s
Rebooting...
[--- Removed the reboot cycle output for this document ----]
```

Once the device finishes rebooting, you will be at the *Amnesiac* prompt. This is the prompt the system give you when there is no configuration on the device. Almost like is it brand new, out of the box!

```
Amnesiac (ttyu0)
login: root
(Note: No prompt for a root password as the system is not yet configured)

--- JUNOS 12.1R2.9 built 2012-05-31 08:58:52 UTC
root@%
```

Cool, now we are logged in.

You will notice that you are at a % prompt. This is actually a BSD type prompt where you can run normal BSD type commands like uname to show the version.

```
root@% uname -a
JUNOS  12.1R2.9 JUNOS 12.1R2.9 #0: 2012-05-31 08:58:52 UTC
builder@greteth:/volume/build/junos/12.1/release/12.1R2.9/obj-
octeon/junos/bsd/kernels/JSRXNLE/kernel  octeon
root@%
```

Ok, enough of that – we need to get to the command line. You do that by entering *cli* from the prompt. Note: You will only need to do this if you are logged in as Root (I believe).

```
root@% cli
root>
```

There, the prompt changed.

Ok, time to see what the running config looks like by issuing the command show configuration:

```
root> show configuration
## Last commit: 2012-08-09 02:41:49 UTC by root
version 12.1R2.9;
system {
   autoinstallation {
      delete-upon-commit; ## Deletes [system autoinstallation] upon change/commit
      traceoptions {
```

```
        level verbose;
        flag {
            all;
        }
    }
    interfaces {
        ge-0/0/0 {
            bootp;
        }
    }
}
name-server {
    208.67.222.222;
    208.67.220.220;
}
services {
    ssh;
    telnet;
    xnm-clear-text;
    web-management {
        http {
            interface vlan.0;
        }
        https {
            system-generated-certificate;
            interface vlan.0;
        }
    }
    dhcp {
        router {
            192.168.1.1;
        }
        pool 192.168.1.0/24 {
            address-range low 192.168.1.2 high 192.168.1.254;
        }
        propagate-settings ge-0/0/0.0;
    }
}
syslog {
    archive size 100k files 3;
    user * {
        any emergency;
    }
    file messages {
        any critical;
        authorization info;
    }
```

```
        file interactive-commands {
            interactive-commands error;
        }
    }
    max-configurations-on-flash 5;
    ##
    ## Warning: statement ignored: unsupported platform (srx210h)
    ##
    max-configuration-rollbacks 5;
    license {
        autoupdate {
            url https://ae1.juniper.net/junos/key_retrieval;
        }
    }
    ## Warning: missing mandatory statement(s): 'root-authentication'
}
interfaces {
    ge-0/0/0 {
        unit 0;
    }
    ge-0/0/1 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members vlan-trust;
                }
            }
        }
    }
    fe-0/0/2 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members vlan-trust;
                }
            }
        }
    }
    fe-0/0/3 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members vlan-trust;
                }
            }
        }
    }
```

```
    fe-0/0/4 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members vlan-trust;
                }
            }
        }
    }
    fe-0/0/5 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members vlan-trust;
                }
            }
        }
    }
    fe-0/0/6 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members vlan-trust;
                }
            }
        }
    }
    fe-0/0/7 {
        unit 0 {
            family ethernet-switching {
                vlan {
                    members vlan-trust;
                }
            }
        }
    }
    vlan {
        unit 0 {
            family inet {
                address 192.168.1.1/24;
            }
        }
    }
}
protocols {
    stp;
}
```

```
security {
    screen {
        ids-option untrust-screen {
            icmp {
                ping-death;
            }
            ip {
                source-route-option;
                tear-drop;
            }
            tcp {
                syn-flood {
                    alarm-threshold 1024;
                    attack-threshold 200;
                    source-threshold 1024;
                    destination-threshold 2048;
                    timeout 20;
                }
                land;
            }
        }
    }
    nat {
        source {
            rule-set trust-to-untrust {
                from zone trust;
                to zone untrust;
                rule source-nat-rule {
                    match {
                        source-address 0.0.0.0/0;
                    }
                    then {
                        source-nat {
                            interface;
                        }
                    }
                }
            }
        }
    }
    policies {
        from-zone trust to-zone untrust {
            policy trust-to-untrust {
                match {
                    source-address any;
                    destination-address any;
                    application any;
```

```
            }
            then {
                permit;
            }
        }
    }
}
zones {
    security-zone trust {
        host-inbound-traffic {
            system-services {
                all;
            }
            protocols {
                all;
            }
        }
        interfaces {
            vlan.0;
        }
    }
    security-zone untrust {
        screen untrust-screen;
        interfaces {
            ge-0/0/0.0 {
                host-inbound-traffic {
                    system-services {
                        dhcp;
                        tftp;
                    }
                }
            }
        }
    }
}
vlans {
    vlan-trust {
        vlan-id 3;
        l3-interface vlan.0;
    }
}

root>
```

WOW! There is a lot of stuff there! The joys of any new device, they usually come with some type of pre-configuration on them. Well, for this lab we don't want any of that, so we will erase the configuration on the device and start from a blank slate.

To delete the config, we need to get into configuration mode (or edit mode)
You can use the *edit* command or *configure* command. I usually use edit. Be warned though, this is actually a hidden command and will not autocomplete.

```
root> edit
Entering configuration mode

[edit]
root#
```

There, we are in edit mode now. Now we should delete the current config. You do that by entering delete from the top most level, that is the level you enter. If you are unsure if you are at the top level, enter the command *top*.

```
[edit]
root# delete
This will delete the entire configuration
Delete everything under this level? [yes,no] (no) yes

[edit]
root#
```

Now we can commit that and figure out what is next.

```
[edit]
root# commit
error: cannot commit an empty configuration
```

Hmm, cannot commit an empty config.
Guess we need to setup the root account and perhaps a user account so that we can access the system.

We will set the system host-name and root-authentication to accept a plain-text password that we enter. For this lab we will use juniper123

```
[edit]
root# set system root-authentication plain-text-password
New password: juniper123
Retype new password: juniper123

[edit]
root# set system host-name JJ1
```

Whoops, we meant to set it to J1. Well, we can delete that line by re-entering it but instead of using *set,* we will use *delete*

```
[edit]
root# delete system host-name JJ1

[edit]
root# set system host-name J1
```

Now we get to create a user for this lab. I will create jfry and assign him as a super-user, set his full name to Jeff Fry, and set his password to juniper123

```
[edit]
root# set system login user jjfry class super-user
```

Uh-oh, we meant to enter jfry and we entered jjfry. So do we need to delete that line and re-add it? Nope. We can use *rename* instead.

```
[edit]
root# rename system login user jjfry to user jfry

[edit]
root# set system login user jfry full-name "Jeff Fry"

[edit]
root# set system login user jfry authentication plain-text-password
New password: juniper123
Retype new password: juniper123
```

Time to look at the configuration before we commit it:

```
root# show
## Last changed: 2012-08-09 02:55:41 UTC
system {
    host-name J1;
    root-authentication {
        encrypted-password "$1$KzNk.qW/$snaQkMp/4d3vZWjO5YONG/"; ## SECRET-DATA
    }
    login {
        user jfry {
            full-name "Jeff Fry";
            class super-user;
            authentication {
                encrypted-password "$1$GlR67aAm$uTukNzdwUDf7VDIBxi6sq/"; ## SECRET-DATA
            }
        }
    }
}

[edit]
```

```
root#
```

You will notice that the output is in a stanza set, if you want to see the set based commands, just issue the command *show | display set*

```
[edit]
root# show | display set
set system host-name J1
set system root-authentication encrypted-password "$1$KzNk.qW/$snaQkMp/4d3vZWjO5YONG/"
set system login user jfry full-name "Jeff Fry"
set system login user jfry class super-user
set system login user jfry authentication encrypted-password
"$1$GlR67aAm$uTukNzdwUDf7VDIBxi6sq/"

[edit]
root#
```

Ok, time to check our config and make sure its ok. To do this, you can issue commit check

```
[edit]
root# commit check
configuration check succeeds
```

Good, lets commit the changes. I will add in a comment for this commit by issuing commit comment "comment goes here"

```
[edit]
root# commit comment "Initial Setup for lab"
commit complete
```

Once you have committed the changes, you are still in edit mode. Just issue the command quote to get back to the cli.

```
[edit]
root@J1# quit
Exiting configuration mode

root@J1>
```

So what did that comment do, well let's see:

```
root@J1> show system commit
0   2012-08-09 02:59:04 UTC by root via cli
    Initial Setup for lab

root@J1>
```

There is our comment below our commit. It is a way that you can associate why you made the change. For business, think of a change control procedure – you can enter the Change number as part of your commit. Taking a lab? You can write the comment after the task number so you can revert if you make a mistake. I can be used for many things – notations of a change control, customer incident number, personal note in a lab, etc.

There we are back at the cli on J1. Now, we need to do a similar config on J2 and J3 for this lab.
The question is, is there an easier way to do this? Yes, there is and it is called *load merge terminal*. You can even load a file from *file* if you wanted to – say a USB drive?

We will merge in this config to the J2 router.

```
system {
   host-name J2;
   root-authentication {
      encrypted-password "$1$KzNk.qW/$snaQkMp/4d3vZWjO5YONG/"; ## SECRET-DATA
   }
   login {
      user jfry {
         full-name "Jeff Fry";
         uid 2002;
         class super-user;
         authentication {
            encrypted-password "$1$GlR67aAm$uTukNzdwUDf7VDIBxi6sq/"; ## SECRET-DATA
         }
      }
   }
}
```

Since we are logged in as root, time to get to the CLI

```
root@% cli
```

And then Edit mode

```
root> edit
Entering configuration mode
```

Now we can delete the default configuration

```
[edit]
root# delete
This will delete the entire configuration
Delete everything under this level? [yes,no] (no) yes
```

Now we can load the config from the terminal. Yup, you use the load merge terminal command and just paste your config in ending with a CTRL-D

```
[edit]
```

```
root# load merge terminal
[Type ^D at a new line to end input]
system {
    host-name J2;
    root-authentication {
        encrypted-password "$1$KzNk.qW/$snaQkMp/4d3vZWjO5YONG/"; ## SECRET-DATA
    }
    login {
        user jfry {
            full-name "Jeff Fry";
            uid 2002;
            class super-user;
            authentication {
                encrypted-password "$1$GlR67aAm$uTukNzdwUDf7VDIBxi6sq/"; ## SECRET-DATA
            }
        }
    }
}
^D load complete
```

There, the config is now loaded!

Time to check out what got imported.

```
[edit]
root# show | display set
set system host-name J2
set system root-authentication encrypted-password "$1$KzNk.qW/$snaQkMp/4d3vZWjO5YONG/"
set system login user jfry full-name "Jeff Fry"
set system login user jfry uid 2002
set system login user jfry class super-user
set system login user jfry authentication encrypted-password
"$1$GlR67aAm$uTukNzdwUDf7VDIBxi6sq/"

[edit]
root#
```

Now we can commit it and we are done with J2 base configuration. I will admit , that is a nice way to get the configuration loaded!

Now to J3:

```
root@% cli
root> edit
Entering configuration mode

[edit]
root# delete
This will delete the entire configuration
```

```
Delete everything under this level? [yes,no] (no) yes


root# load merge terminal
[Type ^D at a new line to end input]

system {
    host-name J3;
    root-authentication {
        encrypted-password "$1$KzNk.qW/$snaQkMp/4d3vZWjO5YONG/"; ## SECRET-DATA
    }
    login {
        user jfry {
            full-name "Jeff Fry";
            uid 2002;
            class super-user;
            authentication {
                encrypted-password "$1$GlR67aAm$uTukNzdwUDf7VDIBxi6sq/"; ## SECRET-DATA
            }
        }
    }
}
^D load complete
[edit]
root# commit and-quit
Exiting configuration mode

root@J3>
```
Cool, J3 done!

One last thing I wanted to cover and that is navigating the stanzas.
Most of the time you will use a single command line to enter a command, but there are times when it is easier to edit a section.

For instance I will use BGP. Instead of using *set protocols* bgp, I will use *edit protocols bgp*

```
[edit]
root@J1# edit protocols bgp

[edit protocols bgp]
root@J1#
```

As you can see, the [edit] line changed to the stanza that I am in [edit protocols bgp].
Now there are a few ways that we can get back to the top of the config [edit].

First, we can enter the command top and that will immediately take up to the top:

```
[edit protocols bgp]
root@J1# top

[edit]
root@J1#
```

We can use up to navigate up one level:

```
[edit]
root@J1# edit protocols bgp

[edit protocols bgp]
root@J1# up

[edit protocols]
root@J1# up

[edit]
root@J1#
```

Or we can enter *up* and a number, here 2, and we will go up that many levels.

```
[edit]
root@J1# edit protocols bgp

[edit protocols bgp]
root@J1# up 2

[edit]
root@J1#
```

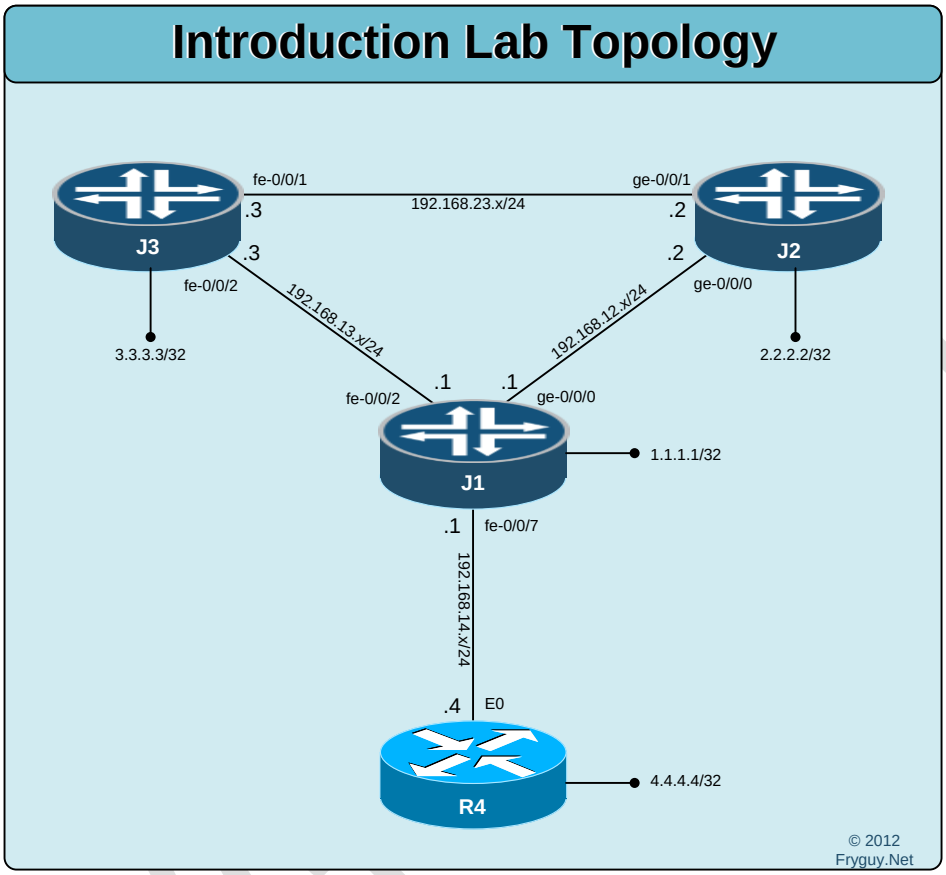
Ok, one more thing, shutting your device down and rebooting.
To reboot, from the main CLI

```
root@J1> request system reboot
Reboot the system ? [yes,no] (no) yes
```

And to power off:

```
root@J1> request system power-off
Power Off the system ? [yes,no] (no) yes
```

Interface Configuration and Connectivity



Now it is time to get some housekeeping done on these routers. We will configure the interfaces on each of them. Once that is complete, we will create a Rescue configuration. A rescue configuration is a known working configuration that we can roll back to at any time. We will use this rescue config to reset the routers to a base state before each lab.

First up though, we need to get R4 (The Cisco router) configured and setup.

For R4 we need to configure E0 with an IP of 192.168.14.4/24 and the loopback with 4..4.4.4/32. Once we have it configured, we will save the config to FLASH as base.txt so we can reload it later on.

```
Router#
Router#conf t
Router (config)#interface Loopback0
Router (config-if)# ip address 4.4.4.4 255.255.255.255
Router (config-if)#exit
Router (config)#interface Ethernet0
Router (config-if)# ip address 192.168.14.4 255.255.255.0
Router (config-if)#no shut
```

```
Router(config-if)#exit
Router(config)#hostname R4
R4(config)#exit
R4#wr mem
Building configuration...
[OK]
R4#copy run flash:base.txt
Destination filename [base.txt]?
Erase flash: before copying? [confirm]n
Verifying checksum...  OK (0xECC2)
991 bytes copied in 2.048 secs (484 bytes/sec)
R4#
```

Ok, R4 has a base configuration on it. Now we can get back to Junos, starting with J1.

J1 specs are as follows:

fe-0/0/7 will have an IP of 192.168.14.1/24
ge-0/0/0 will have an IP of 192.168.12.1/24
fe-0/0/2 will have an IP of 192.168.13.1/24
lo0 will have an IP of 1.1.1.1/32

```
root@J1> edit
Entering configuration mode

[edit]
root@J1# set interfaces fe-0/0/7 unit 0 family inet address 192.168.14.1/24

[edit]
root@J1# set interfaces ge-0/0/0 unit 0 family inet address 192.168.12.1/24

[edit]
root@J1# set interfaces fe-0/0/2  unit 0 family inet address 192.168.13.1/24

[edit]
root@J1# set interfaces lo0 unit 0 family inet address 1.1.1.1/32
```

Ok, let us take a look at what we are about to commit to the router. You do this by issuing the command *show | compare*

```
root@J1# show | compare
[edit]
+  interfaces {
+      ge-0/0/0 {
+          unit 0 {
+              family inet {
+                  address 192.168.12.1/24;
```

```
+          }
+       }
+    }
+    fe-0/0/2 {
+       unit 0 {
+          family inet {
+             address 192.168.13.1/24;
+          }
+       }
+    }
+    fe-0/0/7 {
+       unit 0 {
+          family inet {
+             address 192.168.14.1/24;
+          }
+       }
+    }
+    lo0 {
+       unit 0 {
+          family inet {
+             address 1.1.1.1/32;
+          }
+       }
+    }
+ }

[edit]
root@J1#
```

Ok, let's get this committed and quit the config.

```
[edit]
root@J1# commit and-quit
commit complete
Exiting configuration mode

root@J1>
```

Good, that is done. Now we should be able to PING R4

```
root@J1> ping 192.168.14.4 rapid
PING 192.168.14.4 (192.168.14.4): 56 data bytes
.....
--- 192.168.14.4 ping statistics ---
5 packets transmitted, 0 packets received, 100% packet loss
```

Hmm, it's not pinging. Why?

Ahh!!! these are SRX devices – aka firewalls! We need to disable packet inspection!

```
[edit]
root@J1# set security forwarding-options family inet6 mode packet-based

[edit]
root@J1# set security forwarding-options family mpls mode packet-based

[edit]
root@J1# set security forwarding-options family iso mode packet-based
```

Time to check to see what we will be applying to this SRX as well as J2 and J3!

```
root@J1# show | compare
[edit]
+  security {
+      forwarding-options {
+          family {
+              inet6 {
+                  mode packet-based;
+              }
+              mpls {
+                  mode packet-based;
+              }
+              iso {
+                  mode packet-based;
+              }
+          }
+      }
+  }

[edit]
root@J1#
```

Looking good - let's commit the change.

```
[edit]
root@J1# commit
warning: You have changed mpls flow mode.
You have to reboot the system for your change to take effect.
If you have deployed a cluster, be sure to reboot all nodes.
commit complete

[edit]
root@J1# exit
Exiting configuration mode
```

Time to reboot - the command to do that is request system reboot

```
root@J1> request system reboot
Reboot the system ? [yes,no] (no) yes

Shutdown NOW!
[pid 1660]

root@J1>
*** FINAL System shutdown message from root@J1 ***

System going down IMMEDIATELY
```

While J1 reboots, we should apply those commands to J2 and J3. Again, we will use the load merge command to merge in the following:

```
 security {
    forwarding-options {
       family {
          inet6 {
             mode packet-based;
          }
          mpls {
             mode packet-based;
          }
          iso {
             mode packet-based;
          }
       }
    }
 }
```

J2:

```
[edit]
root@J2# load merge terminal
[Type ^D at a new line to end input]
 security {
    forwarding-options {
       family {
          inet6 {
             mode packet-based;
          }
          mpls {
             mode packet-based;
          }
          iso {
             mode packet-based;
          }
       }
    }
```

```
 }
^D
load complete

[edit]
root@J2# commit and-quit
warning: You have changed mpls flow mode.
You have to reboot the system for your change to take effect.
If you have deployed a cluster, be sure to reboot all nodes.
commit complete
Exiting configuration mode

root@J2> request system reboot
Reboot the system ? [yes,no] (no) yes
```

And now J3:

```
[edit]
root@J3# load merge terminal
[Type ^D at a new line to end input]
 security {
    forwarding-options {
       family {
          inet6 {
             mode packet-based;
          }
          mpls {
             mode packet-based;
          }
          iso {
             mode packet-based;
          }
       }
    }
 }
^D load complete

[edit]
root@J3# commit and-quit
warning: You have changed mpls flow mode.
You have to reboot the system for your change to take effect.
If you have deployed a cluster, be sure to reboot all nodes.
commit complete
Exiting configuration mode

root@J3> request system reboot
Reboot the system ? [yes,no] (no) yes
```

Ok, that is all three of them updated. Now, back to J1 to see if we can PING between J1 and R4.

J1 (ttyu0)

login: jfry
Password:

--- JUNOS 12.1R2.9 built 2012-05-31 08:58:52 UTC
jfry@J1>

Since I logged in as jfry here, right to the CLI!
jfry@J1> ping 192.168.14.4 rapid
PING 192.168.14.4 (192.168.14.4): 56 data bytes
!!!!!
--- 192.168.14.4 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 4.408/6.723/10.290/2.699 ms

jfry@J1>

There we go, that was the problem. Little things like that can drive you nuts!
Oh, and that PING statement, rapid, means it will send 5 rapid ping commands.

Ok, so now that J1 is working, we can finish the config on J2 and J3!

J2 is configured as follows:
ge-0/0/0 with an IP of 192.168.12.2/24
ge-0/0/1 with an IP of 192.168.23.2/24
lo0 with an IP of 2.2.2.2/32

[edit]
jfry@R2# set interfaces ge-0/0/0 unit 0 family inet address 192.168.12.2/24

[edit]
jfry@R2# set interfaces ge-0/0/1 unit 0 family inet address 192.168.23.2/24

[edit]
jfry@R2# set interfaces lo0 unit 0 family inet address 2.2.2.2/32

[edit]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode

Now we should be able to Ping R1's interface of 192.168.12.1

```
jfry@J2> ping 192.168.12.1 rapid
PING 192.168.12.1 (192.168.12.1): 56 data bytes
!!!!!
--- 192.168.12.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 2.374/8.066/29.766/10.853 ms
```

Good, now to J3!

J3 is configured as follows:

fe-0/0/1 with an IP of 192.168.23.3/24
fe-0/0/2 with an IP of 192.168.13.3/24
lo0 with an IP of 3.3.3.3/32

```
[edit]
jfry@J3# set interfaces fe-0/0/1 unit 0 family inet address 192.168.23.3/24

[edit]
jfry@J3# set interfaces fe-0/0/3 unit 0 family inet address 192.168.13.3/24
```

Whoops! That was supposed to be fe-0/0/2, hmm. What can we do? Delete the command and re-enter it all? Nope! Here is another cool feature of Junos, *rename*!

First, here is the interface configuration

```
jfry@J3> show configuration interfaces fe-0/0/3
unit 0 {
   family inet {
      address 192.168.13.3/24;
   }
}

jfry@J3>
```

Now, we let us rename it to fe-0/0/2.

```
jfry@j3> edit
Entering configuration mode

[edit]
jfry@J3# rename interfaces fe-0/0/3 to fe-0/0/2

[edit]
jfry@J3# commit and-quit
```

Now let us take a look at the config for fe-0/0/2

```
jfry@J3> show configuration interfaces fe-0/0/2
unit 0 {
   family inet {
      address 192.168.13.3/24;
   }
}
```

That is a great feature; you can just rename an interface!

Ok, back to the configs.

```
jfry@J3> edit
[edit]
jfry@J3# set interfaces lo0 unit 0 family inet address 3.3.3.3/32

[edit]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode

jfry@J3>
```

Now we should be able to ping R2 192.168.23.2 and R1 192.168.13.1.

```
jfry@J3> ping 192.168.23.2 rapid
PING 192.168.23.2 (192.168.23.2): 56 data bytes
!!!!!
--- 192.168.23.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.803/7.207/28.526/10.660 ms

jfry@J3> ping 192.168.13.1 rapid
PING 192.168.13.1 (192.168.13.1): 56 data bytes
!!!!!
--- 192.168.13.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.914/7.551/28.659/10.559 ms

jfry@J3>
```

Good, we have connectivity!

Now we need to save these configs as Rescue configs. The command to do that is *request system configuration rescue save.* The rescue config is then saved in /config/db/rescue.conf on the system.

J1:
jfry@J1> request system configuration rescue save

J2:
jfry@J2> request system configuration rescue save

J3:
jfry@J3> request system configuration rescue save

Ok, that is all done.

Just a couple of other quick things that you might want to know.

How to check to see who is logged into the system:

```
jfry@J1> show system users
 2:24PM  up 38 mins, 1 user, load averages: 0.19, 0.08, 0.17
USER     TTY      FROM                              LOGIN@  IDLE WHAT
jfry     u0       -                                 1:50PM     - -cli (cli)
```

How to check the uptime on the device and last configuration:

```
jfry@J1> show system uptime
Current time: 2012-08-09 14:24:26 UTC
System booted: 2012-08-09 13:46:52 UTC (00:37:34 ago)
Protocols started: 2012-08-09 13:49:45 UTC (00:34:41 ago)
Last configured: 2012-08-09 13:44:03 UTC (00:40:23 ago) by root
 2:24PM  up 38 mins, 1 user, load averages: 0.17, 0.08, 0.17
```

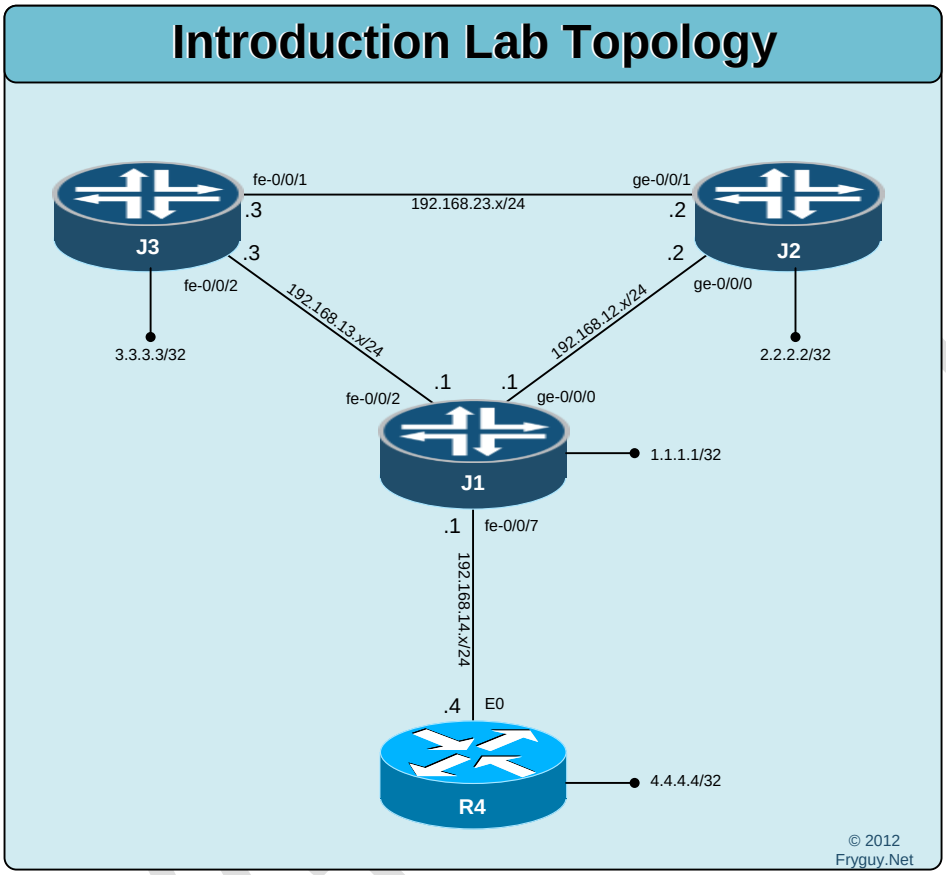
How to disable spacebar auto-completion
To disable the spacebar auto-completion in Junos, you can enter the following command from the prompt (you are not in edit mode)

```
jfry@J1> set cli complete-on-space off
Disabling complete-on-space
```

To turn back on:

```
jfry@J1> set cl com on
Enabling complete-on-space
```

JWeb



Junos devices have a web interface called Jweb. I am not going to cover using JWeb, but I will show you how to enable it and access it.

To enable Jweb on the device, issue the following command and commit it.

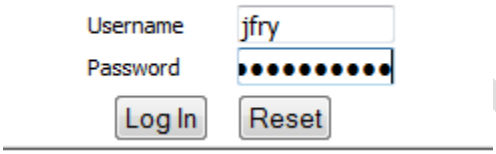
```
[edit]
jfry@J1# set system services web-management http

[edit]
jfry@J1# commit and-quit
commit complete
Exiting configuration mode

jfry@J1>
```

Ok, time to see what this looks like. From a web browser, enter the IP address of the router

http://192.168.14.1

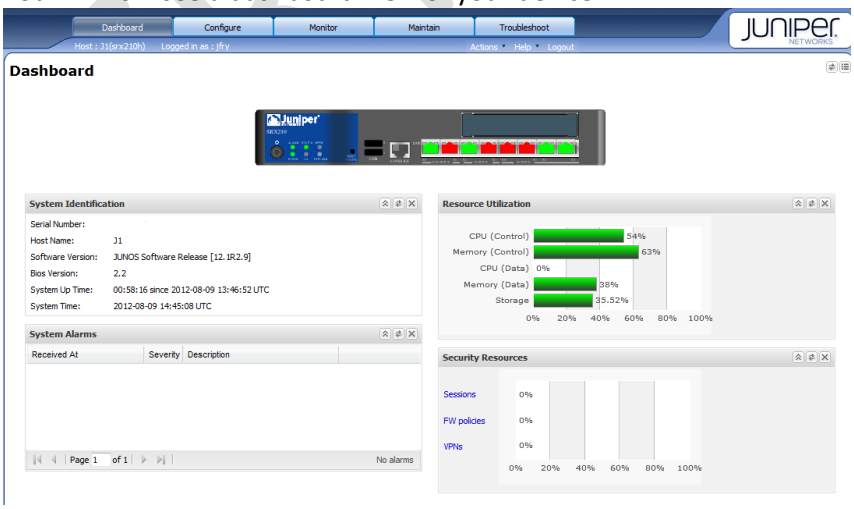
And you will be presented with a login screen

You can go ahead and login as the user you created initially, for me that is jfry, and click the login button.

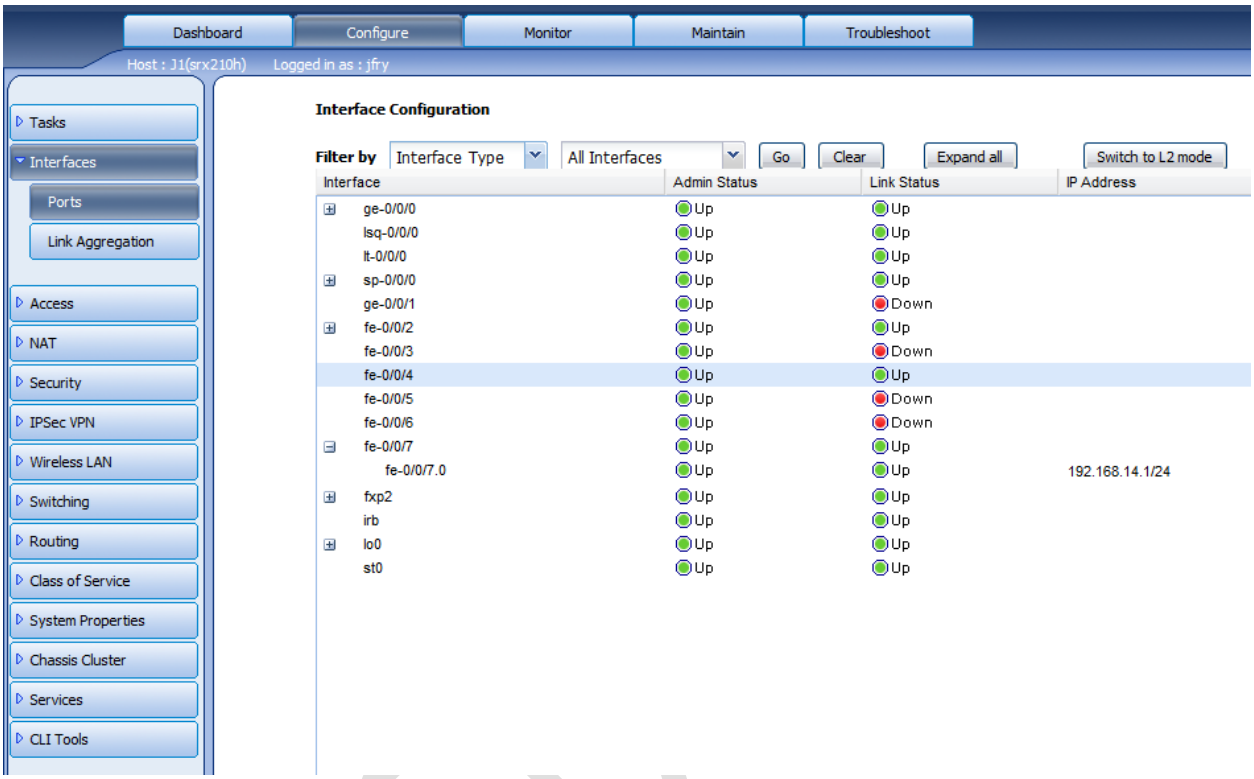


Once you are logged in, you will have a few tabs across the top of the screen, click on Dashboard for now.

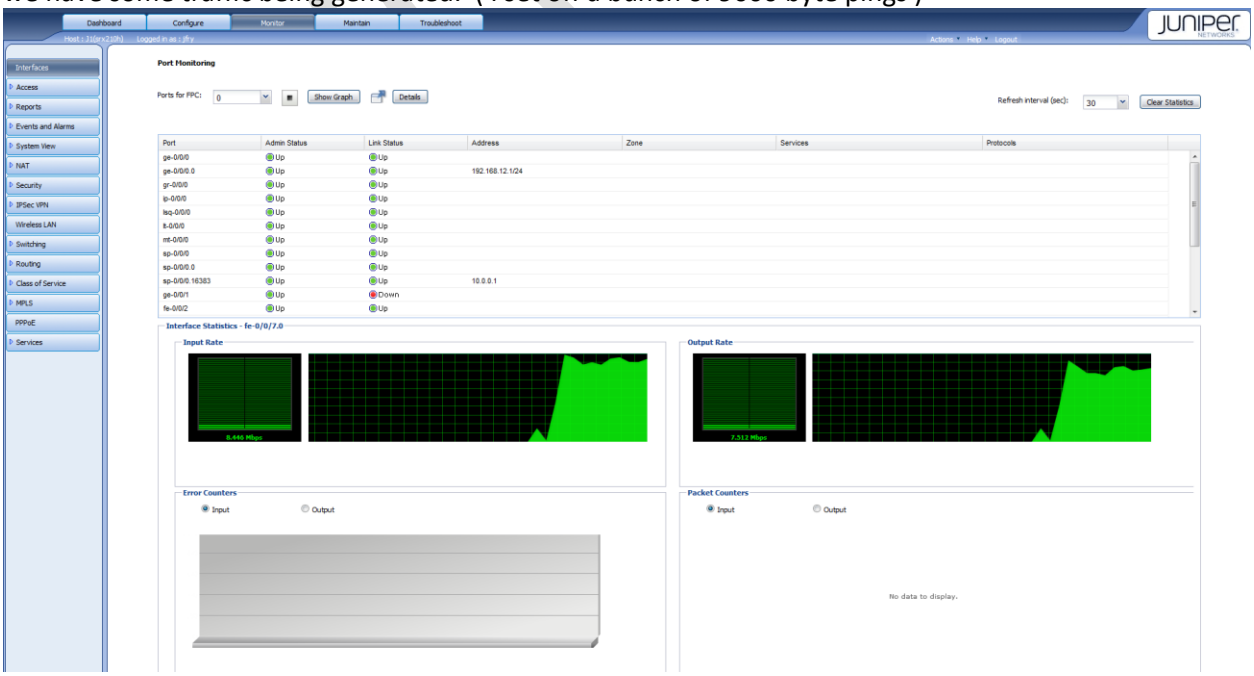
You will now see a dashboard view of your device:



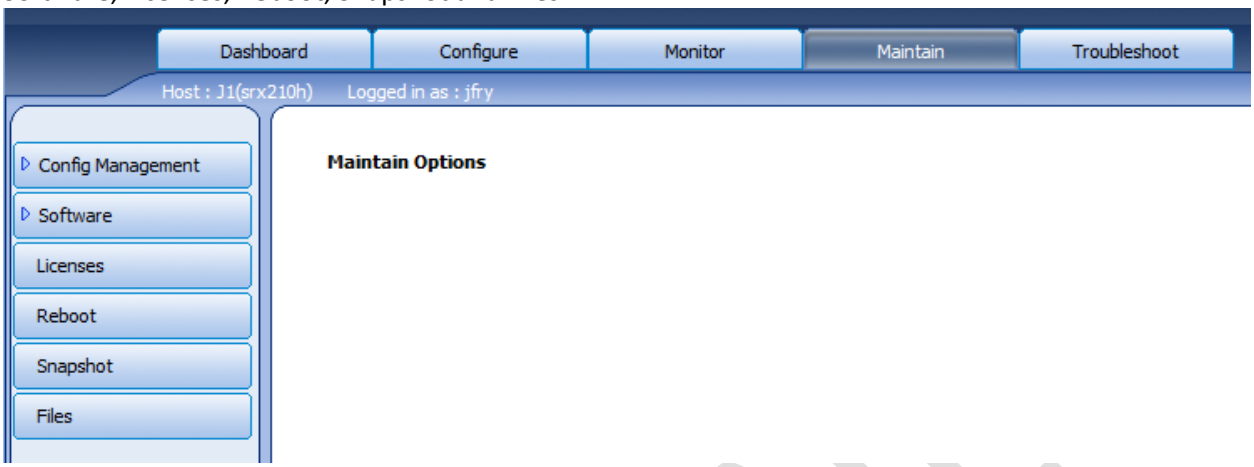
If you look at the Configure tab you will see configuration options on the left hand side of the screen. From these you can configure interfaces, access, NAT, security, etc. They are an easy way to manage the device if need be.



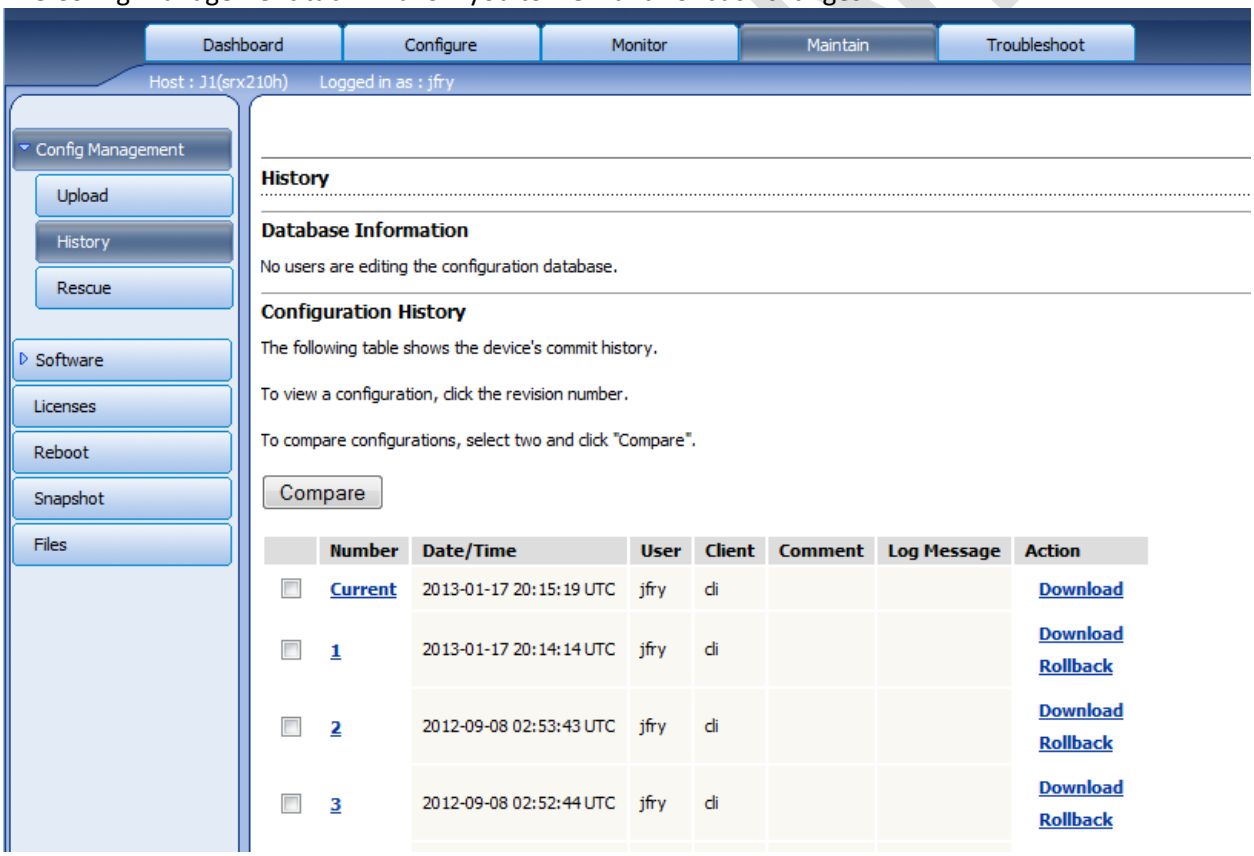
If we look at the monitor tab and select the interface (here fe-0/0/7) that connects us to R4, we can see we have some traffic being generated. (I set off a bunch of 9000 byte pings)



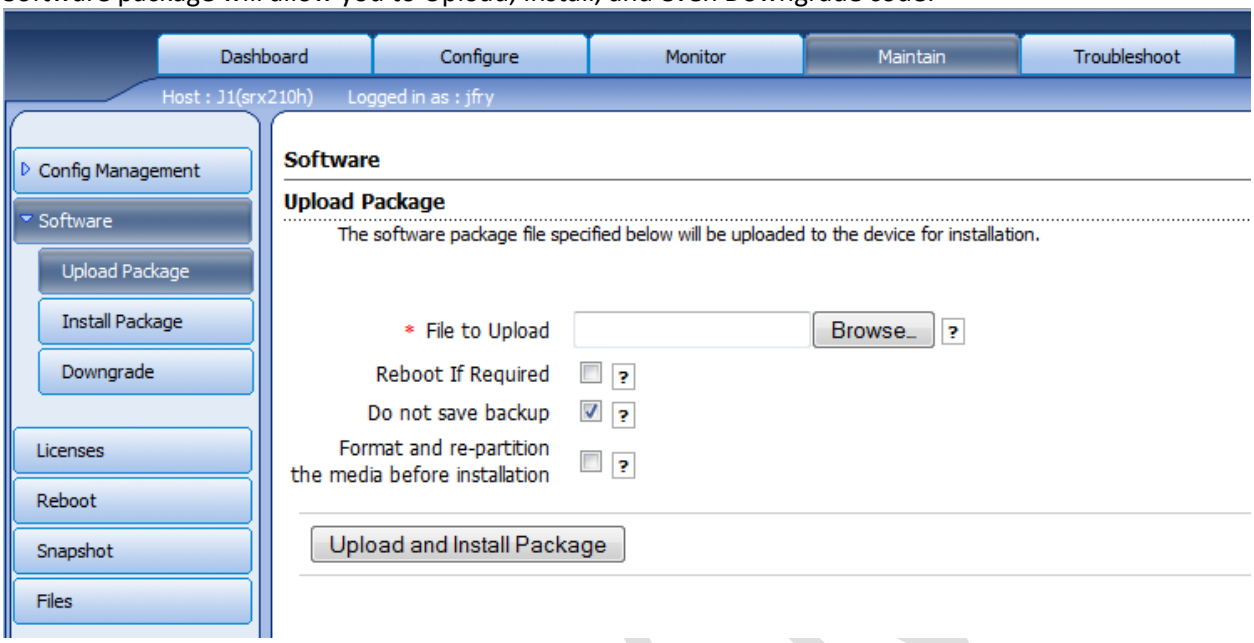
Now on the Maintain tab there are some valuable functions as well. They include Config Management, Software, Licenses, Reboot, Snapshot and Files.



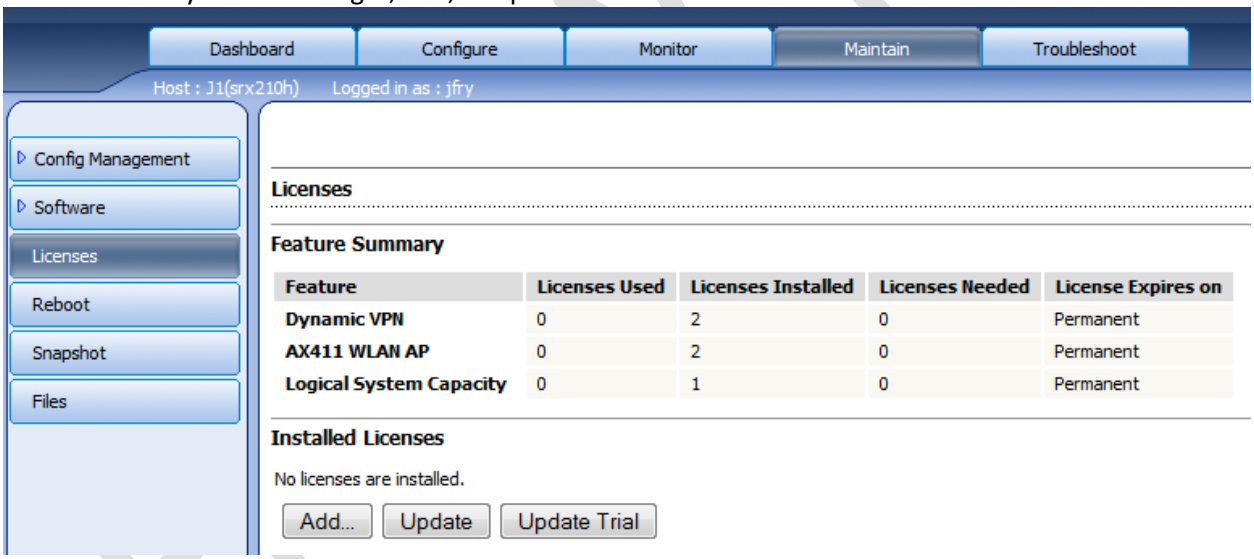
The Config Management tab will allow you to view and rollback changes:



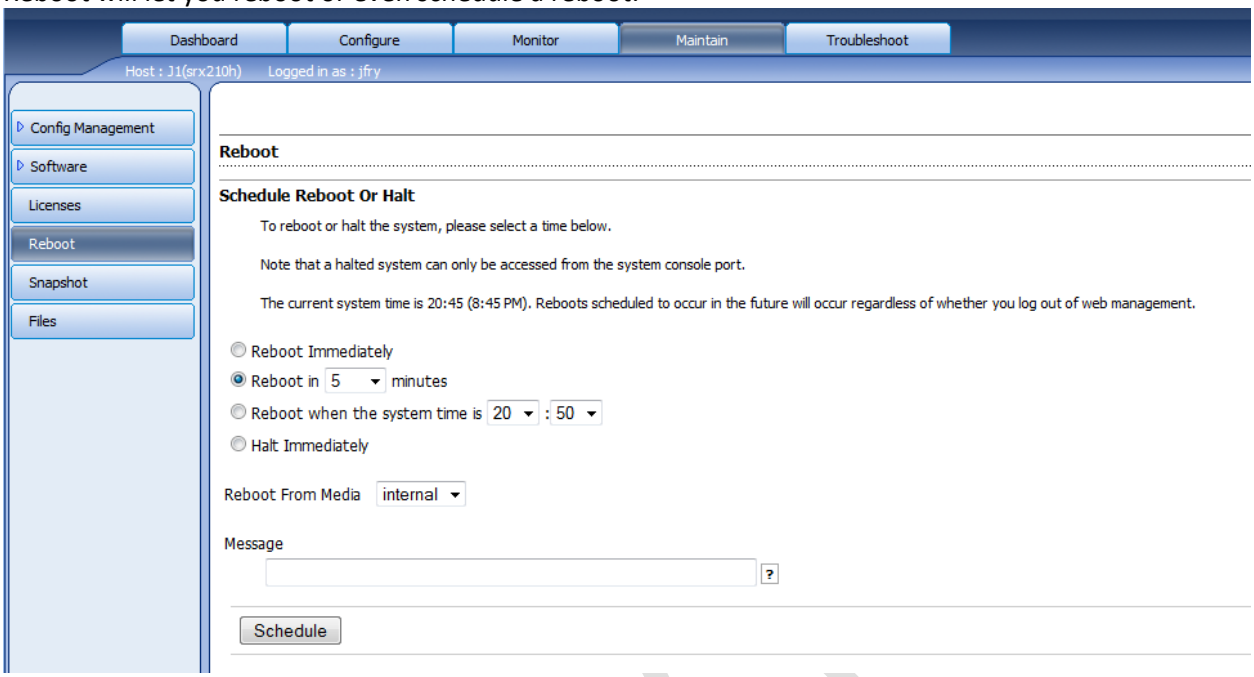
Software package will allow you to Upload, Install, and even Downgrade code:



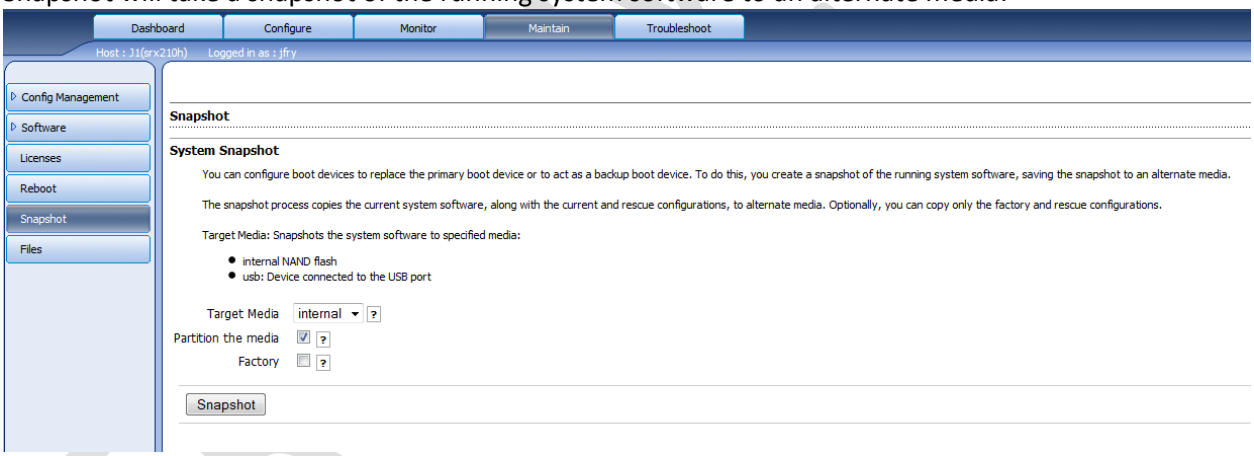
Under licenses you can manager, add, or update licenses:



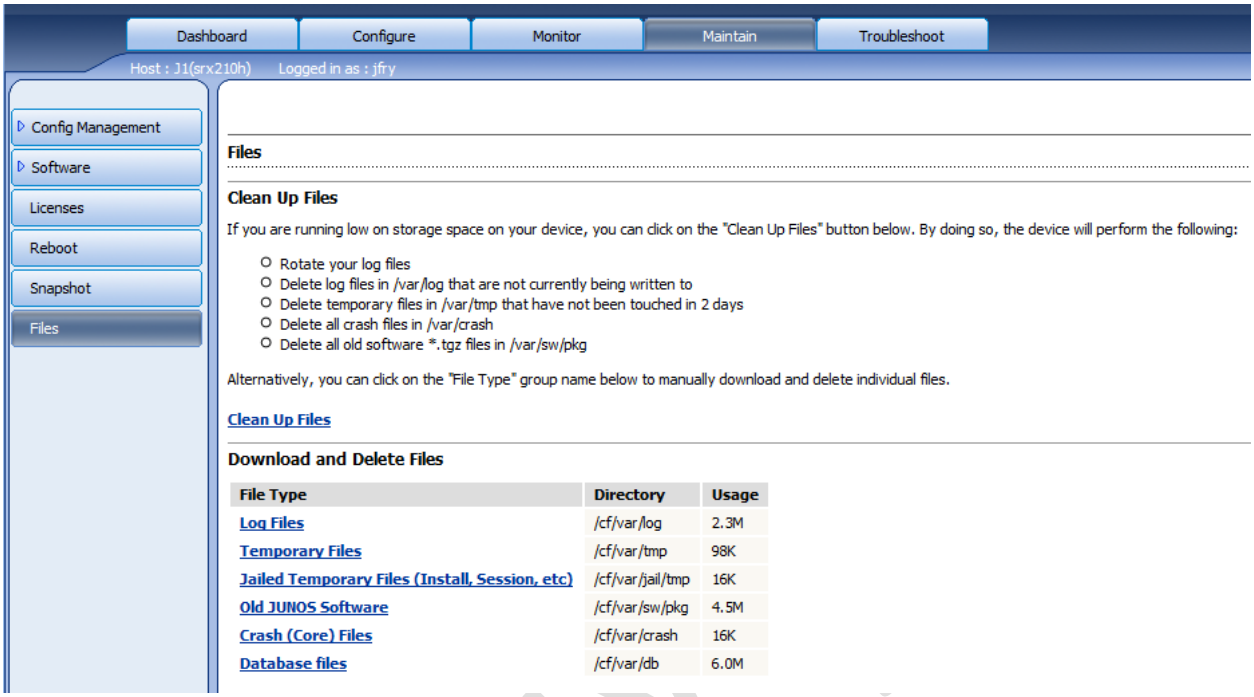
Reboot will let you reboot or even schedule a reboot:



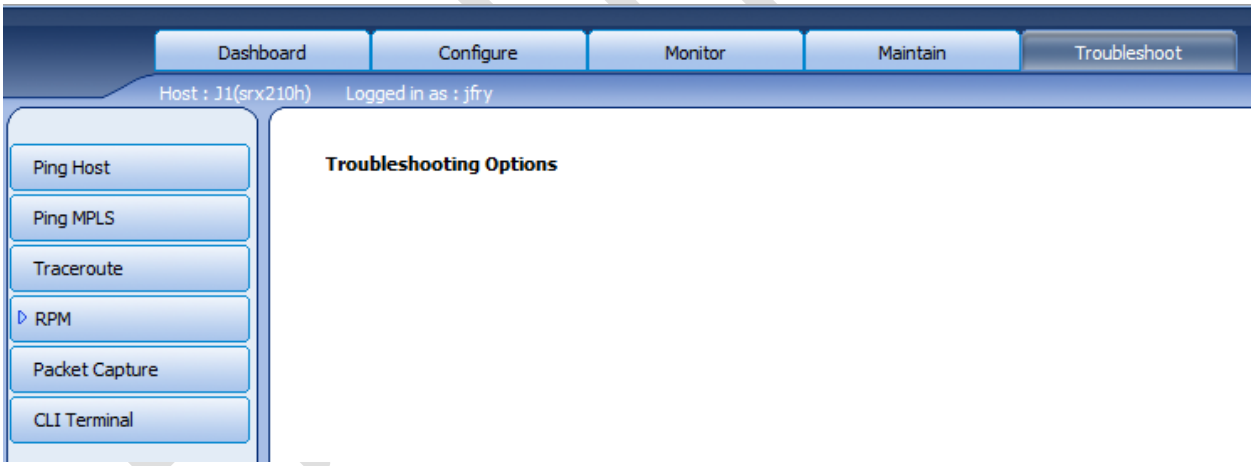
Snapshot will take a snapshot of the running system software to an alternate media:



Files will allow you to download and delete log files.

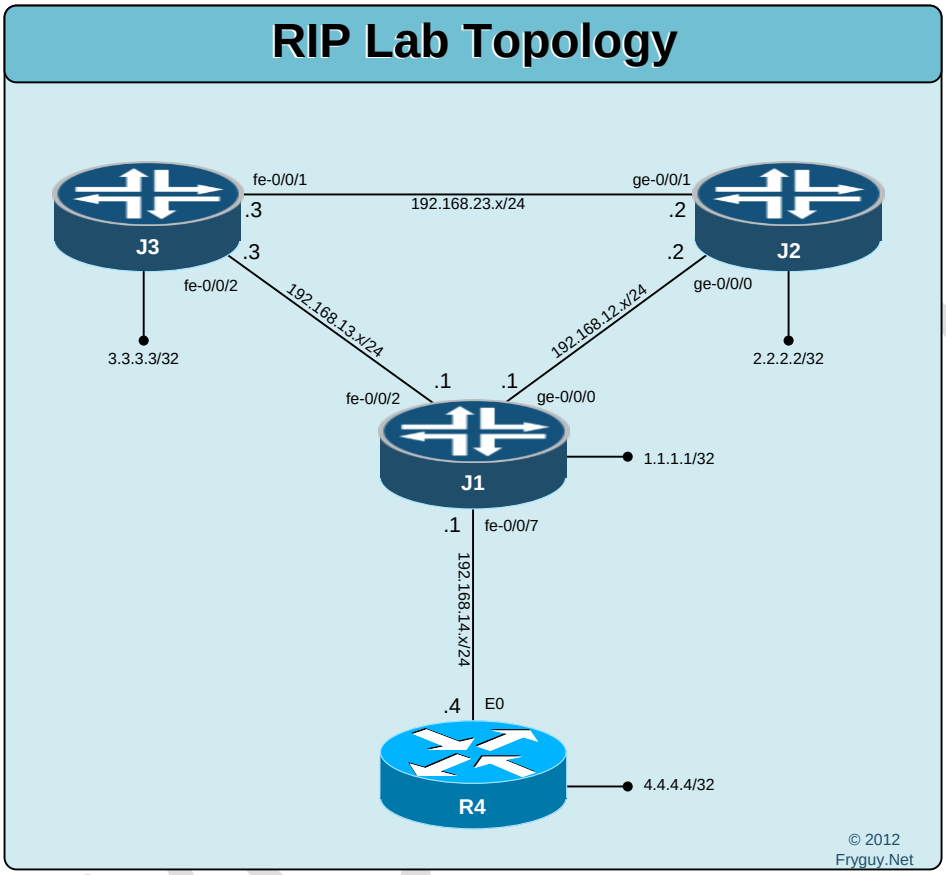


Finally the Troubleshoot tab has some basic tools for troubleshooting the device:



Feel free to explore the menus and options on your own device!

RIP



Ok, time to get some routing. First up, Routing Information Protocol, RIP!

So, first up we will configure the Cisco router, R4 for RIP.

```
R4(config)#router rip
R4(config-router)#ver 2
R4(config-router)#net 192.168.14.0
R4(config-router)#net 4.0.0.0
R4(config-router)#no auto-summary
```

Now onto the Juniper configuration.
J1 is up first.
To configure rip, we need to be under the Protocols stanza

```
[edit]
jfry@J1# edit protocols
```

Once there we configure the Interfaces that we want to participate in RIP. In IOS you configure the networks, in Junos you tell the router what interfaces will participate in RIP. Also, you need to give the process an identifier, here I called it FryguyRIP

```
[edit protocols]
jfry@J1# set rip group FryguyRIP neighbor fe-0/0/7.0

[edit protocols]
jfry@J1# set rip group FryguyRIP neighbor ge-0/0/0.0

[edit protocols]
jfry@J1# set rip group FryguyRIP neighbor fe-0/0/2.0

[edit protocols]
jfry@J1# show | compare
[edit protocols]
+ rip {
+    group FryguyRIP {
+        neighbor fe-0/0/7.0;
+        neighbor ge-0/0/0.0;
+        neighbor fe-0/0/2.0;
+    }
+ }

[edit protocols]
jfry@J1#
```

Time to commit that and see if R4 has routes to R1 interfaces.

```
jfry@J1# commit and-quit
commit complete
Exiting configuration mode

jfry@J1>
```

Now for J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# edit protocols
[edit protocols]
jfry@J2# set rip group FryguyRIP neighbor ge-0/0/0.0

[edit protocols]
jfry@J2# set rip group FryguyRIP neighbor ge-0/0/1.0
```

```
[edit protocols]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode

jfry@J2>
```

and finally J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# edit protocols

[edit protocols]
jfry@J3# set rip group FryguyRIP neighbor fe-0/0/1.0

[edit protocols]
jfry@J3# set rip group FryguyRIP neighbor fe-0/0/2.0

[edit protocols]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode

jfry@J3>
```

Ok, that should be RIP configured. Let's take a look at R4 and see what routes we now have.

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.14.0/24 is directly connected, Ethernet0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
R4#
```

Hmm, no routes. Does J1 have a route?

The way to check the routing table on Junos is with show route table inet.0 (for IPv4)

```
jfry@J1> show route table inet.0

inet.0: 9 destinations, 9 routes (9 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32       *[Direct/0] 02:12:04
                  > via lo0.0
4.4.4.4/32       *[RIP/100] 00:10:08, metric 2, tag 0
                  > to 192.168.14.4 via fe-0/0/7.0
192.168.12.0/24    *[Direct/0] 02:07:48
                  > via ge-0/0/0.0
192.168.12.1/32    *[Local/0] 02:11:25
                    Local via ge-0/0/0.0
192.168.13.0/24    *[Direct/0] 02:08:16
                  > via fe-0/0/2.0
192.168.13.1/32    *[Local/0] 02:11:24
                    Local via fe-0/0/2.0
192.168.14.0/24    *[Direct/0] 02:11:20
                  > via fe-0/0/7.0
192.168.14.1/32    *[Local/0] 02:11:24
                    Local via fe-0/0/7.0
224.0.0.9/32      *[RIP/100] 00:10:09, metric 1
                    MultiRecv

jfry@J1>
```

Yeah, it has a route to R4 loopback.

Here is a difference with Junos and IOS, Junos requires the use of policy-statements to advertise routes. You can think of them as Cisco route-maps to advertise and filter routes in certain protocols. Why is this required, well it has to do with the default import and export polices for the protocols. The default for RIP is to accept all learn routes from neighbors, but reject exporting them to neighbors unless there is a policy that permits it. This is definitely a more secure way to approach routing!

As a bonus to this, this is also how you advertise the loopback interfaces on the Junos router. So, let's create a policy to export RIP routes as well as our loopback address. The use of the *direct* keyword is analogous to *connected* in IOS.

J1 up first!
We will create a policy called RIP_Routes and allow routes from the RIP protocol to be passed

```
[edit]
jfry@J1# set policy-options policy-statement RIP_Routes term 1 from protocol rip
```

As well as let Direct attached networks (loopback) be passed

```
[edit]
jfry@J1# set policy-options policy-statement RIP_Routes term 1 from protocol direct
```

And finally this is the term that means that they can pass
```
[edit]
jfry@J1# set policy-options policy-statement RIP_Routes term 1 then accept
```

Ok, lets take a look at our statement so far
```
jfry@J1# show | compare
[edit]
+  policy-options {
+      policy-statement RIP_Routes {
+          term 1 {
+              from protocol [ rip direct ];
+              then accept;
+          }
+      }
+  }

[edit]
jfry@J1#
```

Ok, now that we have a policy-statement, we now need to apply that to the protocol RIP and to our RIP group, FryguyRIP.
First we will change stanza to the rip protocol
```
[edit]
jfry@J1# edit protocols rip
```

And then configure our export statement:
```
 [edit protocols rip]
jfry@J1# set group FryguyRIP export RIP_Routes
```

Now we can look at our configuration
```
[edit protocols rip]
jfry@J1# top

[edit]
jfry@J1# show | compare
[edit protocols rip group FryguyRIP]
+    export RIP_Routes;
[edit]
+  policy-options {
+      policy-statement RIP_Routes {
+          term 1 {
+              from protocol [ rip direct ];
+              then accept;
+          }
+      }
+  }
```

```
[edit]
jfry@J1#
```

And then commit and it and check R4 for a route to J1 loopback. I have a debut on R4 for ip routing, this way I can see changes.

```
R4#
*Mar  1 03:44:03.419: RT: SET_LAST_RDB for 1.1.1.1/32
  NEW rdb: via 192.168.14.1

*Mar  1 03:44:03.423: RT: add 1.1.1.1/32 via 192.168.14.1, rip metric [120/1]
*Mar  1 03:44:03.423: RT: NET-RED 1.1.1.1/32
*Mar  1 03:44:03.423: RT: NET-RED queued, Queue size 1
R4#
```

Yup, the route to J1 Loopback is in the routing table. Wonder if anything else is there?

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

R    192.168.12.0/24 [120/1] via 192.168.14.1, 00:00:08, Ethernet0
     1.0.0.0/32 is subnetted, 1 subnets
R       1.1.1.1 [120/1] via 192.168.14.1, 00:00:08, Ethernet0
R    192.168.13.0/24 [120/1] via 192.168.14.1, 00:00:08, Ethernet0
C    192.168.14.0/24 is directly connected, Ethernet0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
R4#
```

Nice, we now have routes to J2 and J3 interfaces – but not their loopbacks.
Time to grab the changes from J1 and apply the same ones to J2 and J3.

Here is what we are merging into J2 and J3 configs

```
protocols {
   rip {
      group FryguyRIP {
         export RIP_Routes;
      }
   }
}
```

```
policy-options {
   policy-statement RIP_Routes {
      term 1 {
         from protocol [ rip direct ];
         then accept;
      }
   }
}
```

Time to get these loaded so we have full reachability in this network!

J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# load merge terminal
[Type ^D at a new line to end input]
protocols {
   rip {
      group FryguyRIP {
         export RIP_Routes;
      }
   }
}
policy-options {
   policy-statement RIP_Routes {
      term 1 {
         from protocol [ rip direct ];
         then accept;
      }
   }
}
^D load complete

[edit]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode

jfry@J2>
```

and J3

```
jfry@J3> edit
Entering configuration mode
```

```
[edit]
jfry@J3# load merge terminal
[Type ^D at a new line to end input]
protocols {
   rip {
      group FryguyRIP {
         export RIP_Routes;
      }
   }
}
policy-options {
   policy-statement RIP_Routes {
      term 1 {
         from protocol [ rip direct ];
         then accept;
      }
   }
}
^D load complete

[edit]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode

jfry@J3>
```

Now we can check the routing table on R4:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

R    192.168.12.0/24 [120/1] via 192.168.14.1, 00:00:00, Ethernet0
     1.0.0.0/32 is subnetted, 1 subnets
R       1.1.1.1 [120/1] via 192.168.14.1, 00:00:00, Ethernet0
R    192.168.13.0/24 [120/1] via 192.168.14.1, 00:00:00, Ethernet0
     2.0.0.0/32 is subnetted, 1 subnets
R       2.2.2.2 [120/2] via 192.168.14.1, 00:00:00, Ethernet0
C    192.168.14.0/24 is directly connected, Ethernet0
     3.0.0.0/32 is subnetted, 1 subnets
```

```
R      3.3.3.3 [120/2] via 192.168.14.1, 00:00:00, Ethernet0
    4.0.0.0/32 is subnetted, 1 subnets
C      4.4.4.4 is directly connected, Loopback0
R    192.168.23.0/24 [120/2] via 192.168.14.1, 00:00:01, Ethernet0
R4#
```

Looks great! Let's check J1 to make sure:

```
jfry@J1> show route table inet.0

inet.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[Direct/0] 03:52:17
                    > via lo0.0
2.2.2.2/32         *[RIP/100] 00:01:37, metric 2, tag 0
                    > to 192.168.12.2 via ge-0/0/0.0
3.3.3.3/32         *[RIP/100] 00:01:26, metric 2, tag 0
                    > to 192.168.13.3 via fe-0/0/2.0
4.4.4.4/32         *[RIP/100] 00:08:44, metric 2, tag 0
                    > to 192.168.14.4 via fe-0/0/7.0
192.168.12.0/24    *[Direct/0] 03:48:01
                    > via ge-0/0/0.0
192.168.12.1/32    *[Local/0] 03:51:38
                      Local via ge-0/0/0.0
192.168.13.0/24    *[Direct/0] 03:48:29
                    > via fe-0/0/2.0
192.168.13.1/32    *[Local/0] 03:51:37
                      Local via fe-0/0/2.0
192.168.14.0/24    *[Direct/0] 03:51:33
                    > via fe-0/0/7.0
192.168.14.1/32    *[Local/0] 03:51:37
                      Local via fe-0/0/7.0
192.168.23.0/24    *[RIP/100] 00:01:37, metric 2, tag 0
                    > to 192.168.12.2 via ge-0/0/0.0
                      to 192.168.13.3 via fe-0/0/2.0
224.0.0.9/32       *[RIP/100] 00:04:13, metric 1
                      MultiRecv

jfry@J1>
```

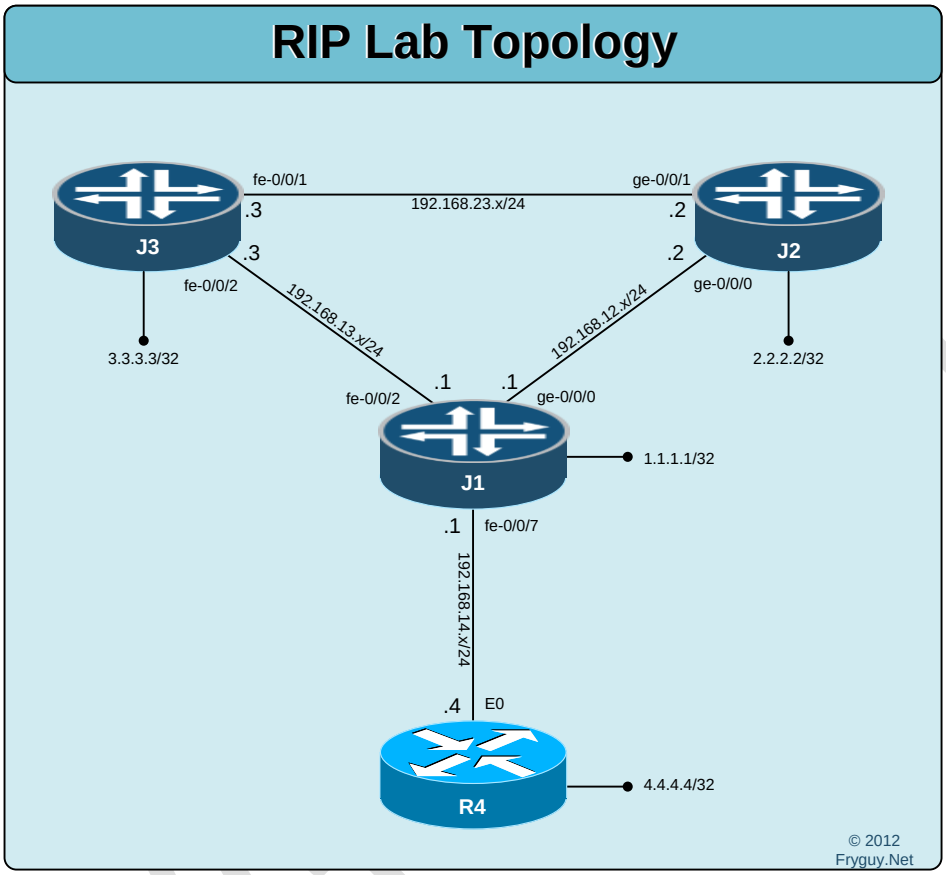
Yup, we have all the routes.

Since R4 is the furthest away, we can test all our PINGs from its loopback

```
R4#p 3.3.3.3 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/8 ms
R4#p 2.2.2.2 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
R4#p 1.1.1.1 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/8 ms
R4#
```

Nice! Full reachability!

RIP Authentication and Preferences



Let's do RIP Authentication first.

First, up – md5 authentication between R4 and J1 only.
For this exercise, we will use the password of JNPRCSCO for the link authentication between the routers.

First up, R4.
Enter configuration commands, one per line. End with CNTL/Z.

```
R4(config)#key chain 1
R4(config-keychain)#key 1
R4(config-keychain-key)#key-string JNPRCSCO
R4(config)#int e0
R4(config-if)#ip rip authentication mode md5
R4(config-if)#ip rip authentication key-chain 1
R4(config-if)#exit
```

Now let's check the routing table:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.14.0/24 is directly connected, Ethernet0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
R4#
```

No routes there, ok – time to configure the other end of this circuit for authentication.

Now onto J1:
We need to configure RIP authentication on the interface connected to R4, fe-0/0/7.0.

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# set protocols rip group FryguyRIP neighbor fe-0/0/7.0 authentication-type md5

[edit]
jfry@J1#set protocols rip group FryguyRIP neighbor fe-0/0/7.0 authentication-key JNPRCSCO

[edit]
jfry@J1# commit and-quit
```

That was it, 2 commands under Junos!

Note: If you wanted to enable authentication for the WHOLE RIP routing process, you would use the commands below. These would then need to be applied to ALL RIP connected routers. For my example, I just did one interface.

```
set protocols rip authentication-type md5
set protocols rip authentication-key JNPRCSCO
```

Now let's see what that looks like in the config. What is cool with Junos is you can just show the config for a section of the config, like below.

```
jfry@J1> show configuration protocols rip
group FryguyRIP {
   export RIP_Routes;
```

```
    neighbor ge-0/0/0.0;
    neighbor fe-0/0/7.0 {
        authentication-type md5;
        authentication-key "$9$OvyZIhydVsY4J36Au1IyrvM87Vs"; ## SECRET-DATA
    }
    neighbor fe-0/0/2.0;
}
```

And back on R4 we have routes!

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

R    192.168.12.0/24 [120/1] via 192.168.14.1, 00:00:07, Ethernet0
     1.0.0.0/32 is subnetted, 1 subnets
R       1.1.1.1 [120/1] via 192.168.14.1, 00:00:07, Ethernet0
R    192.168.13.0/24 [120/1] via 192.168.14.1, 00:00:07, Ethernet0
     2.0.0.0/32 is subnetted, 1 subnets
R       2.2.2.2 [120/2] via 192.168.14.1, 00:00:07, Ethernet0
C    192.168.14.0/24 is directly connected, Ethernet0
     3.0.0.0/32 is subnetted, 1 subnets
R       3.3.3.3 [120/2] via 192.168.14.1, 00:00:07, Ethernet0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
R    192.168.23.0/24 [120/2] via 192.168.14.1, 00:00:08, Ethernet0
R4#
```

Now to setting up metrics for RIP routes.
When you look at the diagram you see that the shortest path between R4 and J2 is via J1. What happens if the link between J1 and J2 is a slow link, it would be faster to have the traffic go R4-J1-J3-J2. So this means that we need to add some metrics to these interfaces to influence the hops.

First let's confirm the path from R4 to J2 with a tracert.

```
R4#traceroute 2.2.2.2

Type escape sequence to abort.
Tracing the route to 2.2.2.2

  1 192.168.14.1 0 msec 4 msec 0 msec
  2 2.2.2.2 0 msec 4 msec 4 msec
R4#
```

Yup, J1-J2.

Ok, lets sent the metric-in on the J2-J1 link, on the J1 side to 5

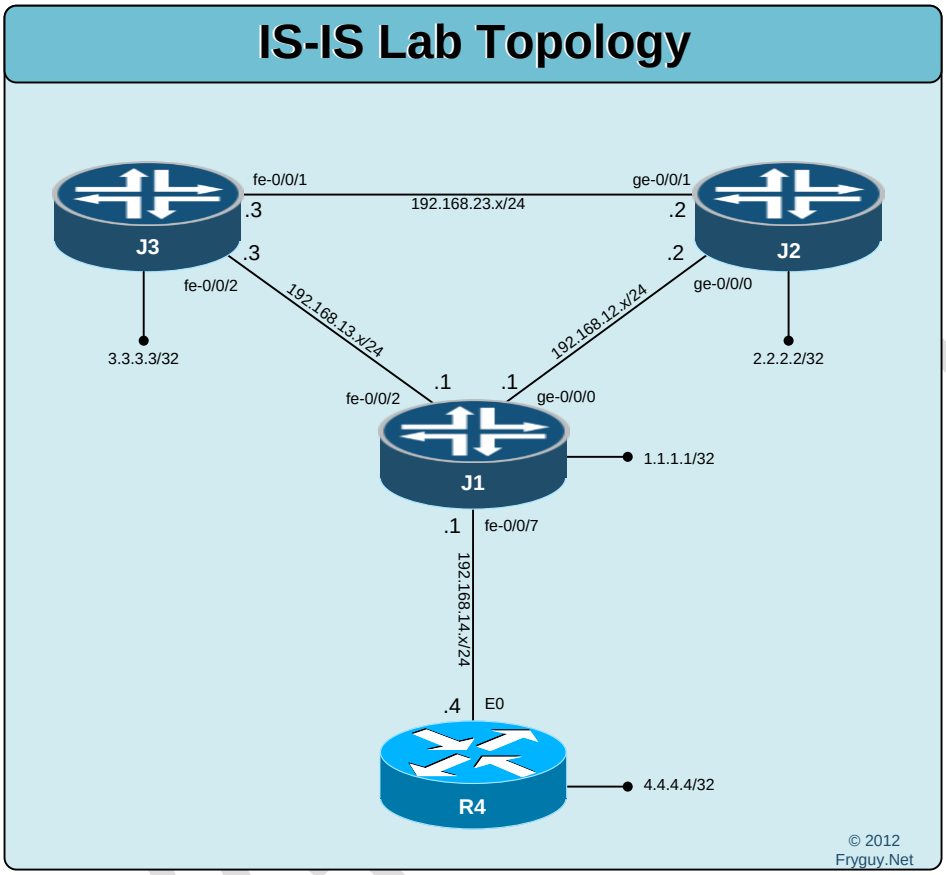
```
[edit[
jfry@J1# set protocols rip group FryguyRIP neighbor ge-0/0/0.0 metric-in 5

[edit]
jfry@J1# commit and-quit
commit complete
Exiting configuration mode

jfry@J1>
```

Now we can check the path from R4 again:

```
R4#traceroute 2.2.2.2

Type escape sequence to abort.
Tracing the route to 2.2.2.2

  1 192.168.14.1 4 msec 0 msec 4 msec
  2 192.168.13.3 0 msec 0 msec 8 msec
  3 2.2.2.2 0 msec 0 msec 0 msec
R4#
```

There we go, R1-R3-R2!

IS-IS



Time to do some IS-IS labs. I am going to try and make these short and simple. I am sure as I get more into Junos I will write more complex IS-IS topologies and start to include LDP as well.

For this I just want to show what an IS-IS configuration would look like.

Up first replacing the config on R4
R4#configure replace flash:base.txt

Ok, that's done – J1, J2, and J3 next.

First up, we need to roll-back to the rescue config. This is done from the *edit* mode by issuing the command *rollback rescue*.

jfry@J1> edit
Entering configuration mode

```
[edit]
jfry@J1# rollback rescue
load complete

[edit]
jfry@J1# commit and-quit
commit complete
Exiting configuration mode

jfry@J1>
```

Let's take a look at the config we have loaded:

```
jfry@J1> show configuration | display set
set version 12.1R2.9
set system host-name J1
set system root-authentication encrypted-password "$1$KzNk.qW/$snaQkMp/4d3vZWjO5YONG/"
set system login user jfry full-name "Jeff Fry"
set system login user jfry uid 2002
set system login user jfry class super-user
set system login user jfry authentication encrypted-password
"$1$GlR67aAm$uTukNzdwUDf7VDIBxi6sq/"
set interfaces ge-0/0/0 unit 0 family inet address 192.168.12.1/24
set interfaces fe-0/0/2 unit 0 family inet address 192.168.13.1/24
set interfaces fe-0/0/7 unit 0 family inet address 192.168.14.1/24
set interfaces lo0 unit 0 family inet address 1.1.1.1/32
set security forwarding-options family inet6 mode packet-based
set security forwarding-options family mpls mode packet-based
set security forwarding-options family iso mode packet-based

jfry@J1>
```

See, back to the base config that we first saved as a 'rescue' config.

Now to J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# rollback rescue
load complete

[edit]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode
```

And J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# rollback rescue
commload complete

[edit]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode

jfry@J3>
```

Ok, time to configure IS-IS on R4, J1, J2, and J3.
For this, we will use 49.0000.0000.0000.000X.00 where X=Router Number
Also for the sake of this lab we will disable Level 1 and only do Level 2.

R4 real quick:

```
R4(config)#router isis Fryguy
R4(config-router)# net 49.0000.0000.0000.0004.00
R4(config-router)#is-type level-2
R4(config-router)#int e0
R4(config-if)#ip router isis Fryguy
R4(config-if)#router isis Fryguy
R4(config-router)#passive-interface Loopback0
R4(config-router)#
```

J1 is up first!

```
jfry@J1> edit
Entering configuration mode
```

First this we do is enable isis on the interfaces, starting with ge-0/0/0. And when we configure this, we will need to disable Level 1 on them.

```
[edit]
jfry@J1# set protocols isis interface ge-0/0/0 level 1 disable

[edit]
jfry@J1# set protocols isis interface fe-0/0/2 level 1 disable

[edit]
jfry@J1# set protocols isis interface fe-0/0/7 level 1 disable
```

Yup, we enable it for the loopback address as well.

```
[edit]
jfry@J1# set protocols isis interface lo0 passive
```

Now we need to enable the ISO family for the interface. ISIS is an iso level protocol, it does not rely on IP or IPv6.

```
[edit]
jfry@J1# set interfaces ge-0/0/0 unit 0 family iso

[edit]
jfry@J1# set interfaces fe-0/0/2 unit 0 family iso

[edit]
jfry@J1# set interfaces fe-0/0/7 unit 0 family iso
```

And under the loopback interface we configure our ISO family address for this router.

```
[edit]
jfry@J1# set interfaces lo0 unit 0 family iso address 49.0000.0000.0000.0001.00
```

Let's look at the config

```
[edit]
jfry@J1# show | compare
[edit interfaces ge-0/0/0 unit 0]
+     family iso;
[edit interfaces fe-0/0/2 unit 0]
+     family iso;
[edit interfaces fe-0/0/7 unit 0]
+     family iso;
 [edit interfaces lo0 unit 0]
+     family iso {
+         address 49.0000.0000.0000.0001.00;
+     }
[edit]
+  protocols {
+     isis {
+         interface ge-0/0/0.0 {
+             level 1 disable;
+         }
+         interface fe-0/0/2.0 {
+             level 1 disable;
+         }
+         interface fe-0/0/7.0 {
+             level 1 disable;
+         }
+         interface lo0.0;
+     }
+  }
```

And then commit and-quit.

```
[edit]
```

```
jfry@J1# commit and-quit
commit complete
Exiting configuration mode
```

Ok, time to do J2 and J3, same way.
J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# set protocols isis interface ge-0/0/0 level 1 disable

[edit]
jfry@J2# set protocols isis interface ge-0/0/1 level 1 disable

[edit]
jfry@J2# set protocols isis interface lo0 passive

[edit]
jfry@J2# set interfaces ge-0/0/0 unit 0 family iso

[edit]
jfry@J2# set interfaces ge-0/0/1 unit 0 family iso

[edit]
jfry@J2# set interfaces lo0 unit 0 family iso address 49.0000.0000.0000.0002.00

[edit]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode

jfry@J2>
```

And now J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# set protocols isis interface fe-0/0/2 level 1 disable

[edit]
jfry@J3# set protocols isis interface fe-0/0/3 level 1 disable

[edit]
jfry@J3# set protocols isis interface lo0 passive
```

```
[edit]
jfry@J3# set interfaces fe-0/0/2 unit 0 family iso

[edit]
jfry@J3# set interfaces fe-0/0/3 unit 0 family iso


[edit]
jfry@J3# set interfaces lo0 unit 0 family iso address 49.0000.0000.0000.0003.00

[edit]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode
```

Ok, now to check the inet.0 routing table on J1:

```
jfry@J1> show route table inet.0

inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[Direct/0] 00:47:08
                    > via lo0.0
2.2.2.2/32         *[IS-IS/18] 00:29:34, metric 10
                    > to 192.168.12.2 via ge-0/0/0.0
3.3.3.3/32         *[IS-IS/18] 00:28:12, metric 10
                    > to 192.168.13.3 via fe-0/0/2.0
4.4.4.4/32         *[IS-IS/18] 00:00:47, metric 10
                    > to 192.168.14.4 via fe-0/0/7.0
192.168.12.0/24    *[Direct/0] 00:46:05
                    > via ge-0/0/0.0
192.168.12.1/32    *[Local/0] 00:46:31
                      Local via ge-0/0/0.0
192.168.13.0/24    *[Direct/0] 00:46:27
                    > via fe-0/0/2.0
192.168.13.1/32    *[Local/0] 00:46:31
                      Local via fe-0/0/2.0
192.168.14.0/24    *[Direct/0] 00:12:32
                    > via fe-0/0/7.0
192.168.14.1/32    *[Local/0] 00:46:31
                      Local via fe-0/0/7.0
192.168.23.0/24    *[IS-IS/18] 00:29:34, metric 20
                    > to 192.168.12.2 via ge-0/0/0.0
```

There we go, we have routes to J2 and J3 loopback interfaces. As you can see, it says they are being advertised by IS-IS.

Now let's configure some Level 2 authentication using MD5 with a key of Juniper
First we will do the Cisco router, R4:

```
R4(config)#key chain ISIS
R4(config-keychain)#key 1
R4(config-keychain-key)#key-string Juniper
R4(config-keychain-key)#router isis Fryguy
R4(config-router)#authentication mode md5
R4(config-router)#authentication key-chain ISIS
```

Now for the Juniper routers, J1 first:

```
[edit]
jfry@J1# set protocols isis level 2 authentication-key Juniper

[edit]
jfry@J1# set protocols isis level 2 authentication-type md5

[edit]
jfry@J1# show | compare
[edit protocols isis]
+    level 2 {
+        authentication-key "$9$cJTrKWNdsJGiLxGik.zFcyl"; ## SECRET-DATA
+        authentication-type md5;
+    }

[edit]
jfry@J1# commit and-quit
commit complete
Exiting configuration mode

jfry@J1>
```

Now we will take that config and merge it into J2 and J3:

```
protocols {
    isis {
        level 2 {
            authentication-key "$9$cJTrKWNdsJGiLxGik.zFcyl"; ## SECRET-DATA
            authentication-type md5;
        }
    }
}
```

J2:

```
jfry@J2# load merge terminal
[Type ^D at a new line to end input]
protocols {
   isis {
      level 2 {
         authentication-key "$9$cJTrKWNdsJGiLxGik.zFcyl"; ## SECRET-DATA
         authentication-type md5;
      }
   }
}

load complete

[edit]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode
```

And now J3:

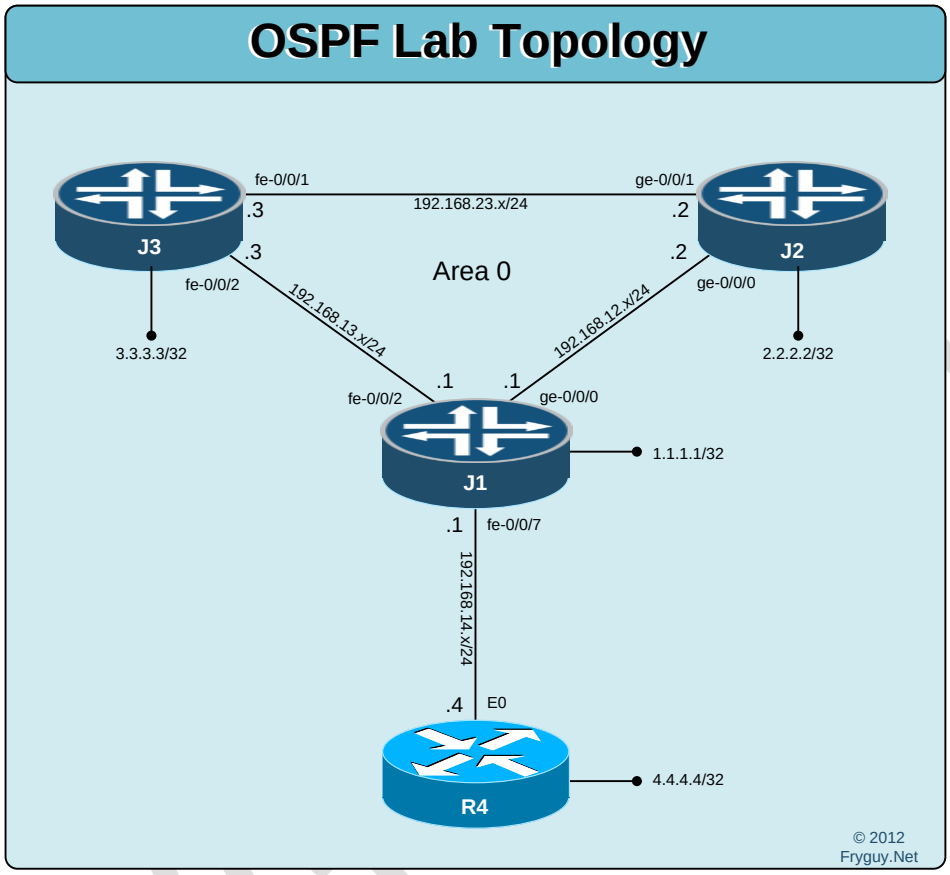
```
jfry@J3# load merge terminal
[Type ^D at a new line to end input]
protocols {
   isis {
      level 2 {
         authentication-key "$9$cJTrKWNdsJGiLxGik.zFcyl"; ## SECRET-DATA
         authentication-type md5;
      }
   }
}

load complete

[edit]
jfry@J3# commit and-quit
```

There, we have area authentication now and we can check by using show isis authentication. Let's look at J1:

```
jfry@J1> show isis authentication
Interface             Level  IIH Auth   CSN Auth   PSN Auth
fe-0/0/2.0            2      MD5        MD5        MD5
fe-0/0/7.0            2      MD5        MD5        MD5
ge-0/0/0.0            2      MD5        MD5        MD5
```

That is about all that I will cover for IS-IS in this lab. Maybe when I get into the MPLS portion I will do more on IS-IS.

OSPF and Rollback



Ok, time to rollback to the rescue configs.

Up first replacing the config on R4 (if you have not done this in the last lab)
R4#configure replace flash:base.txt

Ok, that's done – J1, J2, and J3 next.

First up, we need to roll-back to the rescue config. This is done from the *edit* mode by issuing the command *rollback rescue*.

jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# rollback rescue
load complete

[edit]

```
jfry@J1# commit and-quit
commit complete
Exiting configuration mode

jfry@J1>
```

Now to J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# rollback rescue
load complete

[edit]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode
```

And J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# rollback rescue
load complete

[edit]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode

jfry@J3>
```

Ok, back to the rescue config, now to configure up OSPF!

For this lab we will be using a single OSPF Area, Area 0.

Up first will be R4, we will configure all interfaces in Area 0.

```
R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#router ospf 1
R4(config-router)#net 192.168.14.4 0.0.0.0 a 0
R4(config-router)#net 4.4.4.4 0.0.0.0 a 0
R4(config-router)#no auto-summary
```

```
R4(config-router)#^Z
R4#
```

Ok, now we can configure J1 for OSPF.

```
[edit]
jfry@J1# set protocols ospf area 0 interface fe-0/0/7.0

[edit]
jfry@J1# set protocols ospf area 0 interface ge-0/0/0.0

[edit]
jfry@J1# set protocols ospf area 0 interface fe-0/0/2.0

[edit]
jfry@J1# set protocols ospf area 0 interface lo0.0 passive

[edit]
jfry@J1# commit and-quit
```

Ok, we should check R4 for OSPF neighbor:

```
R4#sh ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
1.1.1.1         128   FULL/BDR        00:00:37    192.168.14.1    Ethernet0
R4#
```

Good, now we should see what that command looks like on J1

```
jfry@J1> show ospf neighbor
Address          Interface              State     ID               Pri  Dead
192.168.14.4     fe-0/0/7.0             Full      4.4.4.4          1    34

jfry@J1>
```

Ok, J1 and R4 are OSPF neighbors. Let's get J2 and J3 configured.

J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# set protocols ospf area 0 interface ge-0/0/0.0

[edit]
jfry@J2# set protocols ospf area 0 interface ge-0/0/1.0

[edit]
jfry@J2# set protocols ospf area 0 interface lo0.0 passive
```

```
[edit]
jfry@J2# commit and-quit
```

J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# set protocols ospf area 0 interface fe-0/0/1.0

[edit]
jfry@J3# set protocols ospf area 0 interface fe-0/0/2.0

[edit]
jfry@J3# set protocols ospf area 0 interface lo0.0 passive

[edit]
jfry@J3# command and-quit
```

Ok, back to R4 to see what the routing table looks like (since it is the furtherst router):

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

O    192.168.12.0/24 [110/11] via 192.168.14.1, 00:04:46, Ethernet0
     1.0.0.0/32 is subnetted, 1 subnets
O       1.1.1.1 [110/10] via 192.168.14.1, 00:04:46, Ethernet0
O    192.168.13.0/24 [110/11] via 192.168.14.1, 00:04:46, Ethernet0
     2.0.0.0/32 is subnetted, 1 subnets
O       2.2.2.2 [110/11] via 192.168.14.1, 00:04:46, Ethernet0
C    192.168.14.0/24 is directly connected, Ethernet0
     3.0.0.0/32 is subnetted, 1 subnets
O       3.3.3.3 [110/11] via 192.168.14.1, 00:04:46, Ethernet0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
O    192.168.23.0/24 [110/12] via 192.168.14.1, 00:04:47, Ethernet0
R4#
```

Looks like we have a full table! Time to PING R3 loopback

```
R4#ping 3.3.3.3 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
R4#
```

We have full connectivity!

Ok, on Cisco if we want to advertise a default route (0/0) with OSPF, we use Default-information originate. Below we will show that, but first we will create a new loopback (Loopback 1) on R4 and assign it an IP of 200.200.200.200.

```
R4(config)#int loop1
R4(config-if)#ip add 200.200.200.200 255.255.255.255
R4(config-if)#
```

Now we should test that we do not currently have connectivity to 200.200.200.200.

```
jfry@J3> show route table inet.0

inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[OSPF/10] 00:49:23, metric 1
                    > to 192.168.13.1 via fe-0/0/2.0
2.2.2.2/32         *[OSPF/10] 00:49:13, metric 1
                    > to 192.168.23.2 via fe-0/0/1.0
3.3.3.3/32         *[Direct/0] 05:48:56
                    > via lo0.0
4.4.4.4/32         *[OSPF/10] 00:31:56, metric 3
                    > to 192.168.13.1 via fe-0/0/2.0
192.168.12.0/24    *[OSPF/10] 00:49:13, metric 2
                      to 192.168.23.2 via fe-0/0/1.0
                    > to 192.168.13.1 via fe-0/0/2.0
192.168.13.0/24    *[Direct/0] 05:47:00
                    > via fe-0/0/2.0
192.168.13.3/32    *[Local/0] 05:48:30
                      Local via fe-0/0/2.0
192.168.14.0/24    *[OSPF/10] 00:49:23, metric 2
                    > to 192.168.13.1 via fe-0/0/2.0
192.168.23.0/24    *[Direct/0] 05:46:36
                    > via fe-0/0/1.0
192.168.23.3/32    *[Local/0] 05:48:30
                      Local via fe-0/0/1.0
```

```
224.0.0.5/32       *[OSPF/10] 00:49:33, metric 1
                      MultiRecv

jfry@J3>
```

Nope, no route nor any default route there.
Time for a PING just to make sure.

```
jfry@J3> ping 200.200.200.200 rapid
PING 200.200.200.200 (200.200.200.200): 56 data bytes
ping: sendto: No route to host
.ping: sendto: No route to host
.ping: sendto: No route to host
.ping: sendto: No route to host
.ping: sendto: No route to host
.
--- 200.200.200.200 ping statistics ---
5 packets transmitted, 0 packets received, 100% packet loss

jfry@J3>
```

Ok, good. Time to configure the Cisco router to advertise a default route.

```
R4(config)#router ospf 1
R4(config-router)#default-information originate always
R4(config-router)#^Z
R4#
```

Ok, J3 should now have a default route:

```
jfry@J3> show route table inet.0 | match 0.0.0.0
0.0.0.0/0          *[OSPF/150] 00:00:27, metric 1, tag 1

jfry@J3>
```

There it is, so now J3 should be able to ping 200.200.200.200

```
jfry@J3> ping 200.200.200.200 rapid
PING 200.200.200.200 (200.200.200.200): 56 data bytes
!!!!!
--- 200.200.200.200 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 3.094/3.538/4.385/0.451 ms

jfry@J3>
```

Good, it can.

So, now that you know how to advertise a default in IOS, we can do the same thing on J3.

First, remove the default and loopback1 interface on R4.

```
R4(config)#router ospf 1
R4(config-router)#no default-information originate  always
R4(config-router)#no int loop1
R4(config)#
```

Now to check J3 and make sure default is gone:

```
jfry@J3> show route table inet.0 | match 0.0.0.0
```

Ok, now we can configure J3 to advertise a default route.
In Junos it is a little bit different. Here we actually need to create the 0/0 route and then write a policy to permit it. This is something that I actually like about Junos, you need to be sure of what you are doing. No need to worry about someone just entering a command and being done.

I suggest that anytime you redistribute a route (Junos or Cisco), a policy should be in place to permit that route. Junos just helps you make sure that happens.

Ok, let's create a null route for 0/0 on J3.
We will configure the router to discard packets that match this statement and to no install the route in the forwarding table.

```
[edit]
jfry@J3# set routing-options static route 0.0.0.0/0 discard

[edit]
jfry@J3# set routing-options static route 0.0.0.0/0 no-install

jfry@J3# show | compare
[edit]
+  routing-options {
+      static {
+          route 0.0.0.0/0 {
+              discard;
+              no-install;
+          }
+      }
+  }
```

Ok, we have the static 0/0 route configured. Now we need to configure the policy to allow this route to be advertised.

```
[edit]
jfry@J3# set policy-options policy-statement Default from protocol static

[edit]
jfry@J3# set policy-statement Default from route-filter 0.0.0.0/0 exact
```

```
[edit]
jfry@J3# set policy-options policy-statement Default then accept

[edit]
jfry@J3# show | compare
[edit]
 +  policy-options {
+     policy-statement Default {
+         from {
+             protocol static;
+             route-filter 0.0.0.0/0 exact;
+         }
+         then accept;
+     }
+ }

[edit]
jfry@J3#
```

Ok, now we need to apply that policy to the OSPF protocol

What is cool with Junos, if you forget what you called the policy, you can hit ? and it will list all the policies configured on the router.

```
jfry@J3# set protocols ospf export ?
Possible completions:
  <value>           Export policy
  (                 Open an expression
  Default
  [                 Open a set of values

[edit]
jfry@J3# set protocols ospf export Default

[edit]
jfry@J3# commit and-quit
```

Now let's get back to R4 and see if we have a default route:

```
R4# sh ip route 0.0.0.0
Routing entry for 0.0.0.0/0, supernet
  Known via "ospf 1", distance 110, metric 0, candidate default path, type extern 2, forward metric 11
  Last update from 192.168.14.1 on Ethernet0, 00:01:31 ago
  Routing Descriptor Blocks:
  * 192.168.14.1, from 3.3.3.3, 00:01:31 ago, via Ethernet0
      Route metric is 0, traffic share count is 1
```

There we go, we have a default route being advertised from R3 (3.3.3.3).

Ok, since we cannot create more than one loopback interface on the SRX we will have to cheat a bit.
I am going to connect J3 fe-0/0/7 to my home network and give it an IP address of 192.168.0.200/24.

```
[edit]
jfry@J3# set interface fe-0/0/7 unit 0 family inet address 192.168.0.200/24

[edit]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode

jfry@J3>
```

Ok, now that is done we should look at R4 and make sure that we do not have a route to 192.168.0.0/24

```
R4#sh ip route 192.168.0.0
% Network not in table
R4#
```

Good, no route. Let's try and PING 192.168.0.200 (J3 interface)

```
R4#ping 192.168.0.200

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.0.200, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
```

And there you go, we can PING the route!

Ok, time to rollback R3 to before we started with all these changes.

So how do we do this? Well, rollback!

For my router, its rollback # 4.

```
jfry@J3> show system commit
0  2012-08-10 21:20:06 UTC by jfry via cli
1  2012-08-10 21:19:03 UTC by jfry via cli
2  2012-08-10 21:17:50 UTC by jfry via cli
3  2012-08-10 21:06:16 UTC by jfry via cli
4  2012-08-10 19:42:50 UTC by jfry via cli
```

You can view the rollback by issuing the command: *show system rollback #*

```
jfry@J3> show system rollback 4
## Last changed: 2012-08-10 19:42:42 UTC
version 12.1R2.9;
```

```
system {
    host-name J3;
    root-authentication {
        encrypted-password "$1$KzNk.qW/$snaQkMp/4d3vZWjO5YONG/"; ## SECRET-DATA
    }
    login {
        user jfry {
            full-name "Jeff Fry";
            uid 2002;
            class super-user;
            authentication {
                encrypted-password "$1$GlR67aAm$uTukNzdwUDf7VDIBxi6sq/"; ## SECRET-DATA
            }
        }
    }
}
interfaces {
    fe-0/0/1 {
        unit 0 {
            family inet {
                address 192.168.23.3/24;
            }
        }
    }
    fe-0/0/2 {
        unit 0 {
            family inet {
                address 192.168.13.3/24;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 3.3.3.3/32;
            }
        }
    }
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface fe-0/0/1.0;
            interface fe-0/0/2.0;
            interface lo0.0 {
                passive;
            }
```

```
        }
    }
}
security {
    forwarding-options {
        family {
            inet6 {
                mode packet-based;
            }
            mpls {
                mode packet-based;
            }
            iso {
                mode packet-based;
            }
        }
    }
}

jfry@J3>
```

And as we can see, that is the config after OSPF was configured but before we did all the static routes.

So, let's roll!(back).
Load the rollback

```
[edit]
jfry@J3# rollback 4
load complete
```

And to see what it is going to change (here remove), do *show | compare*

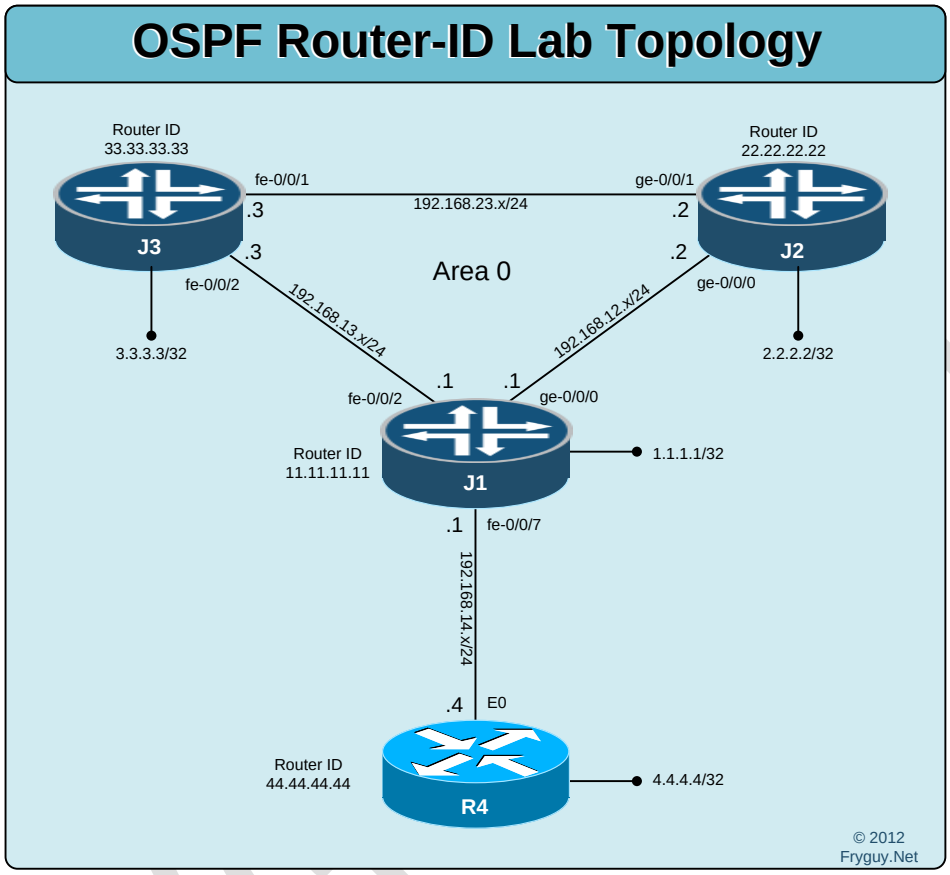
```
[edit]
jfry@J3# show | compare
[edit interfaces]
-   fe-0/0/7 {
-       unit 0 {
-           family inet {
-               address 192.168.0.200/24;
-           }
-       }
-   }
 [edit]
-  routing-options {
-      static {
-          route 0.0.0.0/0 {
-              discard;
-              no-install;
-          }
```

```
-     }
-  }
[edit protocols ospf]
-   export Default;
[edit]
-  policy-options {
-     policy-statement Default {
-        from {
-           protocol static;
-           route-filter 0.0.0.0/0 exact;
-        }
-        then accept;
-     }
-  }

[edit]
jfry@J3#
```

Ok, and commit the config!

Now for more fun stuff with OSPF!

OSPF Router-ID and Traceoptions



Ok, time for some of the other things that we might do with OSPF. First up, router-ids. For this lab, we will create router-ids in the form of xx.xx.xx.xx where x=Router number. For example, R4 will be 44.44.44.44, and we won't use a loopback interface for this.

First we can start with changing it on R4:

```
R4(config)#router ospf 1
R4(config-router)#router-id 44.44.44.44
Reload or use "clear ip ospf process" command, for this to take effect
```

So we have to clear the OSPF process in order for this to take effect.

```
R4(config-router)#^Z
R4#clear ip ospf process
Reset ALL OSPF processes? [no]: y
R4#
```

Ok, we should now have a Router-ID of 44.44.44.44.

```
R4#sh ip ospf  | inc ID
 Routing Process "ospf 1" with ID 44.44.44.44
```

Good. Time to recheck connectivity.

```
R4#ping 3.3.3.3 so lo 0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
R4#
```

Good, we can still ping R3 from R4. Now, let's do the same thing on J2.

But first we will turn on some trace options (debugs) on the Juniper router to see what happens. First we will tell it what log file to use/create, for this example ospf-log is my choice

```
[edit]
jfry@J1# set protocols ospf traceoptions file ospf-log
```

And then we tell it what to log, here restart-signaling.

```
[edit]
jfry@J1# set protocols ospf traceoptions flag restart-signaling
```

And what we will do is now show the log file and have it refresh for us every 30 seconds

```
jfry@J1> show log ospf-log | refresh 30
---(refreshed at 2012-08-13 18:41:29 UTC)---
Aug 13 18:40:10 J1 clear-log[1513]: logfile cleared
Aug 13 18:40:56 trace_on: Tracing to "/var/log/ospf-log" started
---(*more 100%)---
```

Ok, time to change the router-id on J2 to 22.22.22.22

```
[edit]
jfry@J2# set routing-options router-id 22.22.22.22

[edit]
jfry@J2# commit and-quit
commit complete
```

Ok, that is it. No need to reset the process as Junos will do that.

Now, let's see what happened on J1:

```
Aug 13 18:57:18.901347 RPD_OSPF_NBRDOWN: OSPF neighbor 192.168.12.2 (realm ospf-v2 ge-0/0/0.0
area 0.0.0.0) state changed from Full to Init due to 1WayRcvd (event reason: neighbor is in one-way
mode)
Aug 13 18:57:18.959459 RPD_OSPF_NBRUP: OSPF neighbor 192.168.12.2 (realm ospf-v2 ge-0/0/0.0 area
0.0.0.0) state changed from Init to ExStart due to 2WayRcvd (event reason: neighbor detected this
router)
Aug 13 18:57:18.976382 OSPF restart signaling: Received DBD with LR bit on from nbr ip=192.168.12.2
id=22.22.22.22. Save its oob-resync capability 1
```

```
Aug 13 18:57:22.878433 RPD_OSPF_NBRUP: OSPF neighbor 192.168.12.2 (realm ospf-v2 ge-0/0/0.0 area
0.0.0.0) state changed from Exchange to Full due to ExchangeDone (event reason: DBD exchange of
slave completed)
---(*more 100%)---[abort]
```

Yup, we can see we had a neighbor state change.

We can confirm the change by looking at the OSPF neighbors detail information on the J1:

```
jfry@J1> show ospf neighbor detail
Address          Interface              State     ID               Pri  Dead
192.168.13.3     fe-0/0/2.0             Full      3.3.3.3          128    38
  Area 0.0.0.0, opt 0x52, DR 192.168.13.3, BDR 192.168.13.1
  Up 05:10:27, adjacent 05:09:47
192.168.14.4     fe-0/0/7.0             Full      44.44.44.44        1    31
  Area 0.0.0.0, opt 0x52, DR 192.168.14.1, BDR 192.168.14.4
  Up 00:13:29, adjacent 00:13:29
192.168.12.2     ge-0/0/0.0             Full      22.22.22.22      128    34
  Area 0.0.0.0, opt 0x52, DR 192.168.12.1, BDR 192.168.12.2
  Up 00:05:26, adjacent 00:05:26

jfry@J1>
```

As you can see, the neighbor has only been up for about 5 minutes compared to R4 at 13 minutes (that is when we reset the router-id), and J3 is up for over 5 hours.

Ok, time to check the neighbors again (I stepped away for work, so timers will be different) and we can change J3 to 33.33.33.33.

```
jfry@J1> show ospf neighbor detail
Address          Interface              State     ID               Pri  Dead
192.168.13.3     fe-0/0/2.0             Full      3.3.3.3          128    38
  Area 0.0.0.0, opt 0x52, DR 192.168.13.3, BDR 192.168.13.1
  Up 07:06:20, adjacent 07:05:40
192.168.14.4     fe-0/0/7.0             Full      44.44.44.44        1    39
  Area 0.0.0.0, opt 0x52, DR 192.168.14.1, BDR 192.168.14.4
  Up 02:09:22, adjacent 02:09:22
192.168.12.2     ge-0/0/0.0             Full      22.22.22.22      128    36
  Area 0.0.0.0, opt 0x52, DR 192.168.12.1, BDR 192.168.12.2
  Up 02:01:19, adjacent 02:01:19
```

Ok, we have our uptime times now. Time to clear the log on J1

```
jfry@J1> clear log ospf-log
```

Instead of monitoring the log, we will just do a show after we make our change.
We will also setup a repetitive ping from R4 to J3 loopback to see what happens to connectivity.

```
R4#ping 3.3.3.3 so l0 repeat 1000000
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!! (continues)
```

Ok, time to make the change!

```
[edit]
jfry@J3# set routing-options router-id 33.33.33.33

[edit]
jfry@J3# commit and-quit
```

And back to R4 – as you can see, we do lose connectivity to J3 loopback during this change – so be aware that this change will impact the network.

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!.UUUUUUUUUUUU.....!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

And let's look at the log on J1

```
jfry@J1> show log ospf-log
Aug 13 20:58:49 J1 clear-log[1873]: logfile cleared
Aug 13 21:01:17.947876 RPD_OSPF_NBRDOWN: OSPF neighbor 192.168.13.3 (realm ospf-v2 fe-0/0/2.0
area 0.0.0.0) state changed from Full to Init due to 1WayRcvd (event reason: neighbor is in one-way
mode)
Aug 13 21:01:17.992586 RPD_OSPF_NBRUP: OSPF neighbor 192.168.13.3 (realm ospf-v2 fe-0/0/2.0 area
0.0.0.0) state changed from Init to ExStart due to 2WayRcvd (event reason: neighbor detected this
router)
Aug 13 21:01:18.016898 OSPF restart signaling: Received DBD with LR bit on from nbr ip=192.168.13.3
id=33.33.33.33. Save its oob-resync capability 1
Aug 13 21:01:18.107276 RPD_OSPF_NBRUP: OSPF neighbor 192.168.13.3 (realm ospf-v2 fe-0/0/2.0 area
0.0.0.0) state changed from Loading to Full due to LoadDone (event reason: OSPF loading completed)
```

And check our neighbor states:

```
jfry@J1> show ospf neighbor detail
Address          Interface              State     ID               Pri  Dead
192.168.13.3     fe-0/0/2.0             Full      33.33.33.33      128    35
  Area 0.0.0.0, opt 0x52, DR 192.168.13.1, BDR 192.168.13.3
  Up 00:04:33, adjacent 00:04:33
192.168.14.4     fe-0/0/7.0             Full      44.44.44.44        1    35
  Area 0.0.0.0, opt 0x52, DR 192.168.14.1, BDR 192.168.14.4
  Up 02:16:35, adjacent 02:16:35
192.168.12.2     ge-0/0/0.0             Full      22.22.22.22      128    36
  Area 0.0.0.0, opt 0x52, DR 192.168.12.1, BDR 192.168.12.2
  Up 02:08:32, adjacent 02:08:32
```

Now to remove the traceoptions, you just need to delete the section!

```
[edit]
jfry@J1# delete protocols ospf traceoptions

[edit]
jfry@J1# commit and-quit
```

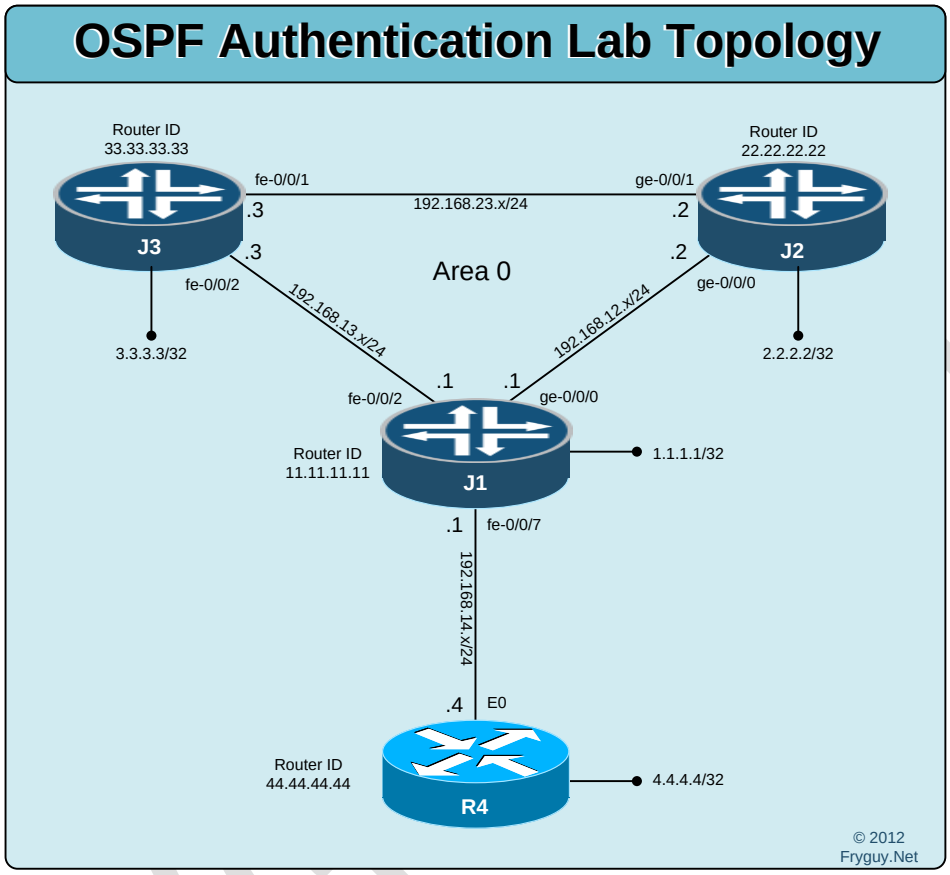
And we can then delete the log

```
jfry@J1> clear log ospf-log
```

…and that is Router-ID and traceoptions!

Now for some OSPF Authentication!

OSPF Authentication



Ok, time for some OSPF Authentication. First up, link authentication!

We will configure authentication on the link between J1 and R4.

R4 up first!

```
R4(config-if)#int e0
R4(config-if)#ip ospf authentication message-digest
R4(config-if)# ip ospf message-digest-key 1 md5 JtoC1234
```

Then across the console comes a message that OSPF Adjacency changed:
*Mar 1 10:05:56.757: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on Ethernet0 from FULL to DOWN, Neighbor Down: Dead timer expired

Ok, time to check J1 and see if the R4 neighbor is down

```
jfry@J1> show ospf neighbor
Address         Interface              State     ID               Pri  Dead
192.168.13.3    fe-0/0/2.0             Full      33.33.33.33      128    37
192.168.12.2    ge-0/0/0.0             Full      22.22.22.22      128    31
```

Good, time to configured J1 for OSPF link authentication

```
[edit]
jfry@J1# set protocols ospf area 0 interface fe-0/0/7 authentication md5 1 key JtoC1234

[edit]
jfry@J1# commit and-quit
```

Ok, we should be back up.

```
jfry@J1> show ospf neighbor
Address         Interface              State     ID               Pri  Dead
192.168.13.3    fe-0/0/2.0             Full      33.33.33.33      128    37
192.168.14.4    fe-0/0/7.0             Full      44.44.44.44        1    38
192.168.12.2    ge-0/0/0.0             Full      22.22.22.22      128    39

jfry@J1>
```

We have neighbors, now to check to make sure they are MD5 authenticated

```
jfry@J1> show ospf interface fe-0/0/7.0 detail
Interface          State   Area            DR ID           BDR ID          Nbrs
fe-0/0/7.0         DR      0.0.0.0         1.1.1.1         44.44.44.44        1
  Type: LAN, Address: 192.168.14.1, Mask: 255.255.255.0, MTU: 1500, Cost: 1
  DR addr: 192.168.14.1, BDR addr: 192.168.14.4, Priority: 128
  Adj count: 1
  Hello: 10, Dead: 40, ReXmit: 5, Not Stub
  Auth type: MD5, Active key ID: 1, Start time: 1970 Jan  1 00:00:00 UTC
  Protection type: None
  Topology default (ID 0) -> Cost: 1

jfry@J1>
```

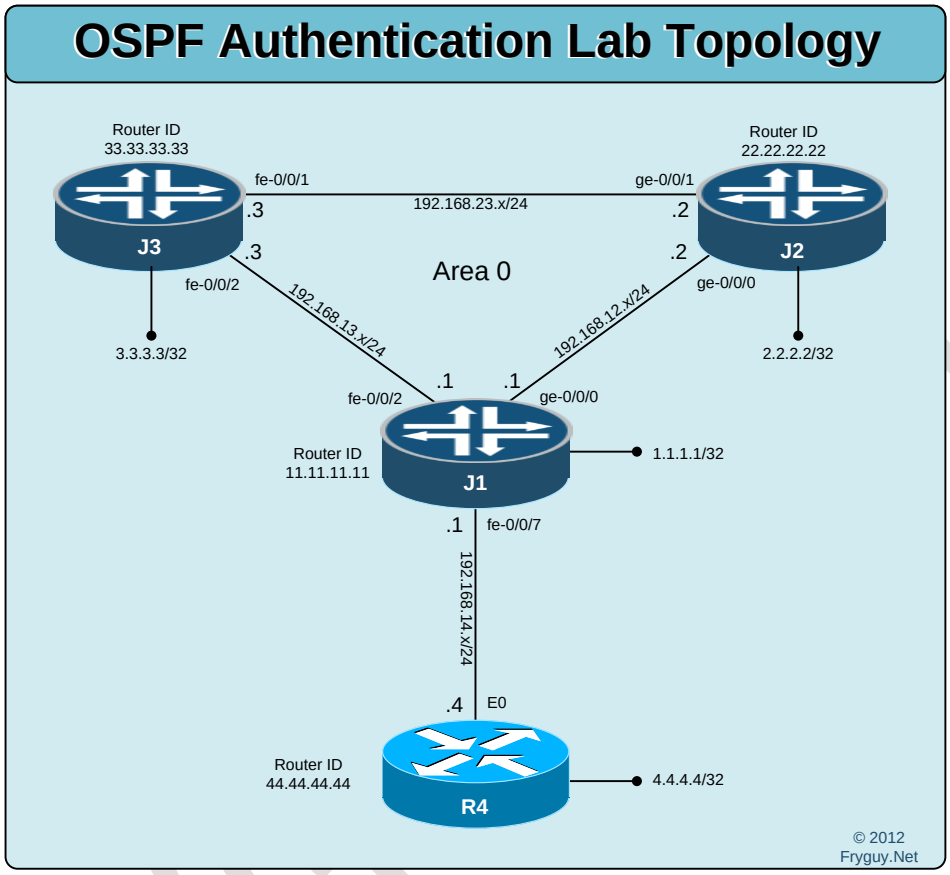
Good, auth type is MD5 and Active Key is 1!

Time to ping R3 from R4 loopback to test!

```
R4#ping 3.3.3.3 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/8 ms
R4#
```

Now time to configure Area authentication!

OSPF Authentication – Area Auth



For this lab we will configure authentication for Area 0

First up some quick housecleaning
J1:

```
[edit]
jfry@J1# delete protocols ospf area 0 interface fe-0/0/7 authentication
[edit]
jfry@J1# commit and-quit
commit complete
Exiting configuration mode

jfry@J1>
```

and R4

```
R4(config)#int e0
R4(config-if)#no ip ospf authentication
R4(config-if)#no ip ospf message-digest-key 1
R4(config-if)#^Z
```

R4 up first!
Configure it for the area
```
R4(config)#router ospf 1
R4(config-router)#area 0 authentication message-digest
```

And then add our key under the interface:
```
R4(config-router)#int e0
R4(config-if)#ip ospf message-digest-key 1 md5 JunosIOS
R4(config-if)#
```

And there goes the neighborhood!
```
*Mar  1 10:28:16.905: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on Ethernet0 from FULL to DOWN,
Neighbor Down: Dead timer expired
R4(config-if)#
```

Time for J1!
```
[edit]
jfry@J1# set protocols ospf area 0.0.0.0 interface fe-0/0/7.0 authentication md5 1 key JunosIOS
[edit]
jfry@J1# set protocols ospf area 0.0.0.0 interface ge-0/0/0.0 authentication md5 1 key JunosIOS
[edit]
jfry@J1# set protocols ospf area 0.0.0.0 interface fe-0/0/2.0 authentication md5 1 key JunosIOS
[edit]
jfry@j1# commit and-quit
```

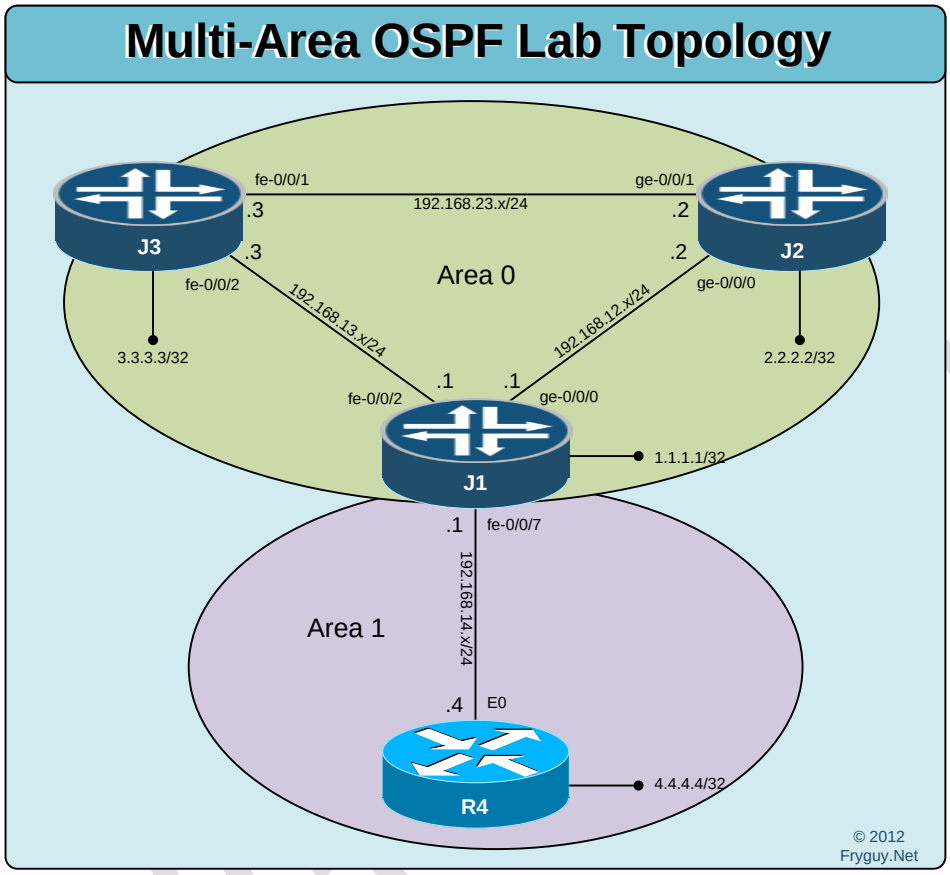
Hey, that command looks familiar! That is because it is the same command we ran before ☺

Now for J2:
```
[edit]
jfry@J2# set protocols ospf area 0.0.0.0 interface ge-0/0/0.0 authentication md5 1 key JunosIOS
[edit]
jfry@J2# set protocols ospf area 0.0.0.0 interface ge-0/0/1.0 authentication md5 1 key JunosIOS
[edit]
jfry@J2# commit and-quit
```

and J3:
```
[edit]
jfry@J3# set protocols ospf area 0.0.0.0 interface fe-0/0/1.0 authentication md5 1 key JunosIOS
[edit]
jfry@J3# set protocols ospf area 0.0.0.0 interface fe-0/0/2.0 authentication md5 1 key JunosIOS
[edit]
jfry@J3# commit and-quit
```

And like that, we have OSPF authentication. Not so much area on this one as Junos

OSPF Multi-Area, Stub, and NSSA



Ok, first thing we need to do is rollback to our rescue config so we start on a clean slate:
R4:

```
R4#configure replace flash:base.txt
```

J1:

```
[edit]
jfry@J1# rollback rescue
load complete
[edit]
jfry@J1# commit and-quit
commit complete
Exiting configuration mode
```

J2:

```
[edit]
jfry@J2# rollback rescue
load complete
[edit]
jfry@J2# commit and-quit
```

```
commit complete
Exiting configuration mode
```

J3:

```
[edit]
jfry@J3# rollback rescue
load complete
[edit]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode
```

OK, time to configure Area 0 between J1, J2, and J3:
J1:

```
[edit]
jfry@J1# set protocols ospf area 0 interface ge-0/0/0

[edit]
jfry@J1# set protocols ospf area 0 interface fe-0/0/2

[edit]
jfry@J1# set protocols ospf area 0 interface lo0.0 passive

[edit]
jfry@J1# commit and-quit
```

Ok, J2 time:

```
[edit]
jfry@J2# set protocols ospf area 0 interface lo0.0 passive

[edit]
jfry@J2# set protocols ospf area 0 interface ge-0/0/0

[edit]
jfry@J2# set protocols ospf area 0 interface ge-0/0/1

[edit]
jfry@J2# commit and-quit
```

And now J3:

```
[edit]
jfry@J3# set protocols ospf area 0 interface lo0.0 passive

[edit]
jfry@J3# set protocols ospf area 0 interface fe-0/0/1
```

```
[edit]
jfry@J3# set protocols ospf area 0 interface fe-0/0/2

[edit]
jfry@J3# commit and-quit
```

Now if we look at our ospf neighbors, we should be all neighbored up!

```
jfry@J1> show ospf neighbor
Address         Interface              State     ID               Pri  Dead
192.168.13.3    fe-0/0/2.0             Full      3.3.3.3          128    33
192.168.12.2    ge-0/0/0.0             Full      2.2.2.2          128    39

jfry@J1>
```

Good, now we need to configure J1 fe-0/0/7 in Area 1 and R4 in Area 1.
R4 first:

```
R4(config)#router ospf 1
R4(config-router)#net 192.168.14.4 0.0.0.0 a 1
R4(config-router)#net 4.4.4.4 0.0.0.0 a 1
R4(config-router)#
```

And now J1:

```
[edit]
jfry@J1# set protocols ospf area 1 interface fe-0/0/7

[edit]
jfry@J1# commit and-quit
```

And now R4 should be able to ping R3 loopback:

```
R4#p 3.3.3.3 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
R4#
```

Good! That is multi-area OSPF!

Time to configure Area 1 as a Stub area!
R4 up first!

```
R4(config)#router ospf 1
R4(config-router)#area 1 stub
R4(config-router)#
```

And now J1:

```
[edit]
jfry@J1# set protocols ospf area 1 stub

[edit]
jfry@J1# commit and-quit
```

And there you have it, stub configured!

Ok, now time to make area 1 a NSSA area.

First, we need to create an exit point from R4, for this we will add a static null route for 200.0.0.0/8.

```
R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#ip route 200.0.0.0 255.0.0.0 null 0
```

Now we need to remove the STUB command from OSPF

```
R4(config)#router ospf 1
R4(config-router)#no area 1 stub
```

And now make it a NSSA area

```
R4(config-router)#area 1 nssa
```

And then redistribute our static subnets

```
R4(config-router)#redistribute static subnets
R4(config-router)#^Z
R4#
```

Ok, now we need to make the change on J1:

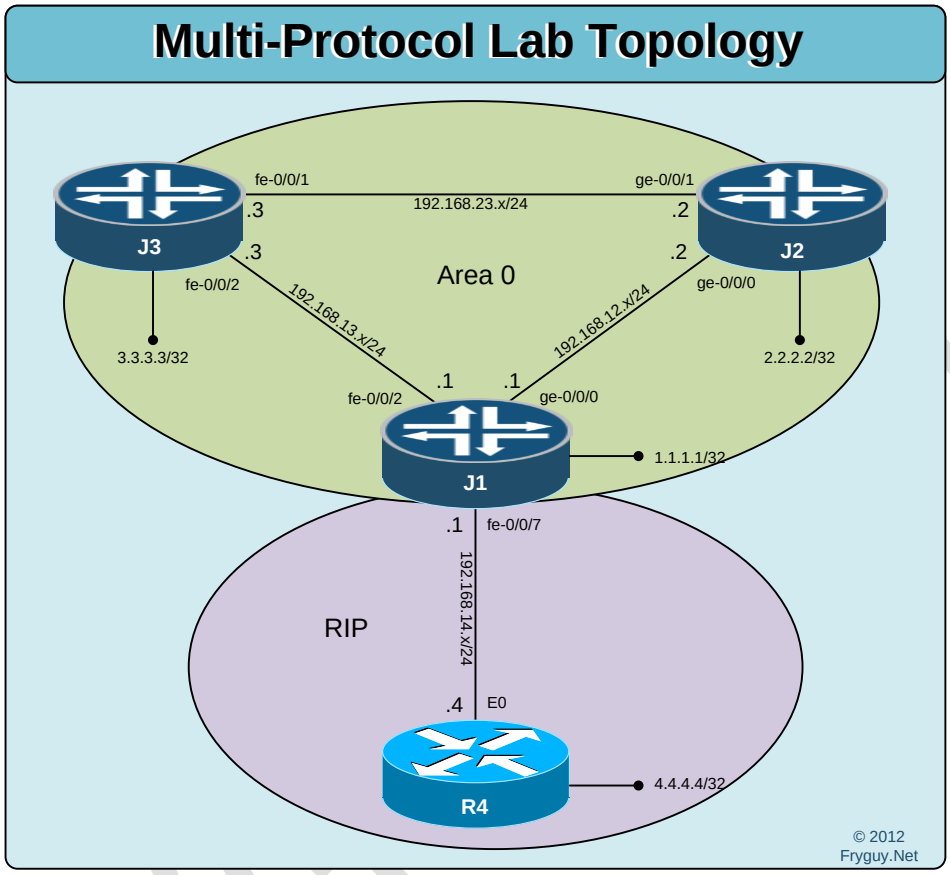
```
[edit]
jfry@J1# set protocols ospf area 1 nssa

[edit]
jfry@J1# commit and-quit
```

Ok, now J3 should have a route to 200.0.0.0/8

```
jfry@J3> show route 200.0.0.0/8

inet.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

200.0.0.0/8        *[OSPF/150] 00:00:14, metric 20, tag 0
                 > to 192.168.13.1 via fe-0/0/2.0
```

There we go!

Multi-Protocol Lab – OSPF and RIP



Ok, we have done RIP and we have done OSPF. Now time to put them together!

For this lab the Juniper devices will be in OSPF Area 0 and the Cisco device will be in RIP. J1 will sit in both RIP and OSPF and handle the redistribution between the protocols.

First up, we need to restore R4 config to our base and remove fe-0/0/7 from Area 1 on J1.
R4:
R4#configure replace flash:base.txt

And J1:
[edit]
jfry@J1# delete protocols ospf area 1 nssa

[edit]
jfry@J1# delete protocols ospf area 1 interface fe-0/0/7

[edit]
jfry@J1# commit and-quit

Ok, that is done. Time to configure RIP on R4 and J1.
R4:

```
R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#router rip
R4(config-router)#ver 2
R4(config-router)#no au
R4(config-router)#net 192.168.14.0
R4(config-router)#net 4.0.0.0
R4(config-router)#^Z
R4#
```

Ok, now can configure J1 for RIP to R4, also we will advertise our Loopback to R4.

Ok, since we know we need to advertise our loopback to R4, we should create a prefix list to permit that route

```
[edit]
jfry@J1# set policy-options prefix-list loopback 1.1.1.1/32
```

Ok, time to create our policy statements. We will use terms here since we will be adding more to these later on in this lab.

```
 [edit]
jfry@J1# edit policy-options policy-statement FromR4 term 1

[edit policy-options policy-statement FromR4 term 1]
jfry@J1# set from protocol rip

[edit policy-options policy-statement FromR4 term 1]
jfry@J1# set then accept

[edit policy-options policy-statement FromR4 term 1]
jfry@J1# up

[edit policy-options policy-statement FromR4]
jfry@J1# up

[edit policy-options]
jfry@J1# edit policy-statement ToR4

[edit policy-options policy-statement ToR4]
jfry@J1# set term 1 from protocol direct

[edit policy-options policy-statement ToR4]
jfry@J1# set term 1 from prefix-list loopback

[edit policy-options policy-statement ToR4]
jfry@J1# set term 1 then accept
```

```
[edit policy-options policy-statement ToR4]
jfry@J1# up
```

Ok, time to check our policy-options section to see what we have so far and make sure it all looks right.

```
[edit policy-options]
jfry@J1# show
prefix-list loopback {
    1.1.1.1/32;
}
policy-statement FromR4 {
    term 1 {
        from protocol rip;
        then accept;
    }
}
policy-statement ToR4 {
    term 1 {
        from {
            protocol direct;
            prefix-list loopback;
        }
        then accept;
    }
}

[edit policy-options]
jfry@J1# top
```

Now to configure RIP:

```
[edit]
jfry@J1# set protocols rip group Fryguy neighbor fe-0/0/7.0
```

And our export/import groups:

```
[edit]
jfry@J1# set protocols rip group Fryguy export ToR4

[edit]
jfry@J1# set protocols rip group Fryguy import FromR4
```

Ok, time to look over all the changes before we commit them:

```
 [edit]
jfry@J1# show | compare
[edit]
+  protocols {
+      rip {
+          group Fryguy {
```

```
+            export ToR4;
+            import FromR4;
+            neighbor fe-0/0/7.0;
+        }
+    }
+ }
+ policy-options {
+    prefix-list loopback {
+        1.1.1.1/32;
+    }
+    policy-statement FromR4 {
+        term 1 {
+            from protocol rip;
+            then accept;
+        }
+    }
+    policy-statement ToR4 {
+        term 1 {
+            from {
+                protocol direct;
+                prefix-list loopback;
+            }
+            then accept;
+        }
+    }
+ }

[edit]
jfry@J1# commit and-quit
commit complete
Exiting configuration mode
```

Ok, now let's take a look at the routing table on R4:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
R       1.1.1.1 [120/1] via 192.168.14.1, 00:00:03, Ethernet0
C    192.168.14.0/24 is directly connected, Ethernet0
```

```
    4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
R4#
```

Perfect, we have a route to J1 Loopback.
Let's see what J1 shows for routes for RIP

```
jfry@J1> show route protocol rip

inet.0: 9 destinations, 9 routes (9 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

4.4.4.4/32         *[RIP/100] 01:39:28, metric 2, tag 0
                  > to 192.168.14.4 via fe-0/0/7.0
224.0.0.9/32       *[RIP/100] 00:45:27, metric 1
                    MultiRecv

jfry@J1>
```

Perfect, we have a route to R4 loopback.
Time to PING!

```
jfry@J1> ping 4.4.4.4 source 1.1.1.1 rapid
PING 4.4.4.4 (4.4.4.4): 56 data bytes
!!!!!
--- 4.4.4.4 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 4.119/4.536/4.882/0.268 ms

jfry@J1>
```

Excellent, we have RIP connectivity. Time for OSPF!
First up, we can quickly configure J2 and J3 for OSPF area 0
J2:
Instead of using a single line, I will actually edit the protocols area. It accomplishes the same things, just uses less repetitive commands

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# edit protocols ospf area 0
```

As you can see, the top edit line actually changes to the context you are editing.

```
[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface ge-0/0/1

[edit protocols ospf area 0.0.0.0]
 jfry@J2# set interface ge-0/0/0
```

```
[edit protocols ospf area 0.0.0.0]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode
```

…and J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface fe-0/0/1

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface fe-0/0/2

[edit protocols ospf area 0.0.0.0]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode
```

Now we can do J1:

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface fe-0/0/2

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface ge-0/0/0

[edit protocols ospf area 0.0.0.0]
jfry@J1# commit and-quit
```

Ok, we should have OSPF connectivity between J1, J2, and J3 now

```
jfry@J1> show route protocol ospf

inet.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2.2.2.2/32         *[OSPF/10] 00:00:17, metric 1
```

```
                > to 192.168.12.2 via ge-0/0/0.0
3.3.3.3/32        *[OSPF/10] 00:00:17, metric 1
                > to 192.168.13.3 via fe-0/0/2.0
192.168.23.0/24    *[OSPF/10] 00:00:17, metric 2
                > to 192.168.12.2 via ge-0/0/0.0
                  to 192.168.13.3 via fe-0/0/2.0
224.0.0.5/32       *[OSPF/10] 00:00:27, metric 1
                  MultiRecv

jfry@J1>
```

Good.

Now we can look at the routing table on R1, R4, and R2:
R4:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
R       1.1.1.1 [120/1] via 192.168.14.1, 00:00:13, Ethernet0
C    192.168.14.0/24 is directly connected, Ethernet0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
R4#
```

J1:

```
jfry@J1> show route

inet.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[Direct/0] 05:13:21
                  > via lo0.0
2.2.2.2/32         *[OSPF/10] 00:00:34, metric 1
                  > to 192.168.12.2 via ge-0/0/0.0
3.3.3.3/32         *[OSPF/10] 00:00:34, metric 1
                  > to 192.168.13.3 via fe-0/0/2.0
4.4.4.4/32         *[RIP/100] 01:48:50, metric 2, tag 0
                  > to 192.168.14.4 via fe-0/0/7.0
```

```
192.168.12.0/24    *[Direct/0] 05:12:17
                    > via ge-0/0/0.0
192.168.12.1/32    *[Local/0] 05:12:43
                      Local via ge-0/0/0.0
192.168.13.0/24    *[Direct/0] 05:12:38
                    > via fe-0/0/2.0
192.168.13.1/32    *[Local/0] 05:12:42
                      Local via fe-0/0/2.0
192.168.14.0/24    *[Direct/0] 05:12:38
                    > via fe-0/0/7.0
192.168.14.1/32    *[Local/0] 05:12:42
                      Local via fe-0/0/7.0
192.168.23.0/24    *[OSPF/10] 00:00:34, metric 2
                    > to 192.168.12.2 via ge-0/0/0.0
                      to 192.168.13.3 via fe-0/0/2.0
224.0.0.5/32       *[OSPF/10] 00:00:44, metric 1
                      MultiRecv
224.0.0.9/32       *[RIP/100] 00:00:44, metric 1
                      MultiRecv

jfry@J1>
```

and J2:

```
jfry@J2> show route

inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2.2.2.2/32         *[Direct/0] 05:14:11
                    > via lo0.0
3.3.3.3/32         *[OSPF/10] 05:12:21, metric 1
                    > to 192.168.23.3 via ge-0/0/1.0
192.168.12.0/24    *[Direct/0] 05:13:11
                    > via ge-0/0/0.0
192.168.12.2/32    *[Local/0] 05:13:16
                      Local via ge-0/0/0.0
192.168.13.0/24    *[OSPF/10] 00:01:27, metric 2
                    > to 192.168.12.1 via ge-0/0/0.0
                      to 192.168.23.3 via ge-0/0/1.0
192.168.23.0/24    *[Direct/0] 05:13:11
                    > via ge-0/0/1.0
192.168.23.2/32    *[Local/0] 05:13:16
                      Local via ge-0/0/1.0
224.0.0.5/32       *[OSPF/10] 05:14:13, metric 1
                      MultiRecv

jfry@J2>
```

There, as you can see R4 only has a route to J1 loopback; J1 has a route to everyone's loopback, and J2 only had a route to J1 and J3 loopback.

Now we can configure J1 to redistribute (aka import/export) the routes as we see fit.

To do this we need to edit our RIP import/export statement and create an import statement for OSPF.

First up, lets create a policy statement called ToOSPF that will accept anything from the RIP protocol.

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# set policy-options policy-statement ToOSPF term 1 from protocol rip

[edit]
jfry@J1# set policy-options policy-statement ToOSPF term 1 then accept
```

Ok, now we can edit our policy-statement ToR4 and add term 2 to accept routes from OSPF area 0

```
[edit]
jfry@J1# set policy-options policy-statement ToR4 term 2 from protocol ospf area 0.0.0.0

[edit]
jfry@J1# set policy-options policy-statement ToR4 term 2 then accept
```

Now we need to apply our export statement to send the routes to OSPF

```
[edit]
jfry@J1# set protocols ospf export ToOSPF
```

We do not need to edit RIP import/export since we just added a second term to the existing policy!

Quick look at what we are doing:

```
[edit]
jfry@J1# show | compare
[edit protocols ospf]
+   export ToOSPF;
[edit policy-options]
+   policy-statement ToOSPF {
+       term 1 {
+           from protocol rip;
+           then accept;
+       }
+   }
[edit policy-options policy-statement ToR4]
    term 1 { ... }
+   term 2 {
+       from {
```

```
+          protocol ospf;
+          area 0.0.0.0;
+      }
+      then accept;
+   }
```

And run a quick check:

```
[edit]
jfry@J1# commit check
configuration check succeeds
```

And Commit the changes!

```
[edit]
jfry@J1# commit and-quit
```

Now we can check the routes on R4 and J3:

R4:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
R       1.1.1.1 [120/1] via 192.168.14.1, 00:00:14, Ethernet0
     2.0.0.0/32 is subnetted, 1 subnets
R       2.2.2.2 [120/1] via 192.168.14.1, 00:00:14, Ethernet0
C    192.168.14.0/24 is directly connected, Ethernet0
     3.0.0.0/32 is subnetted, 1 subnets
R       3.3.3.3 [120/1] via 192.168.14.1, 00:00:14, Ethernet0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
R    192.168.23.0/24 [120/1] via 192.168.14.1, 00:00:14, Ethernet0
R4#
```

J3:

```
jfry@J3> show route

inet.0: 9 destinations, 9 routes (9 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2.2.2.2/32         *[OSPF/10] 06:18:01, metric 1
```

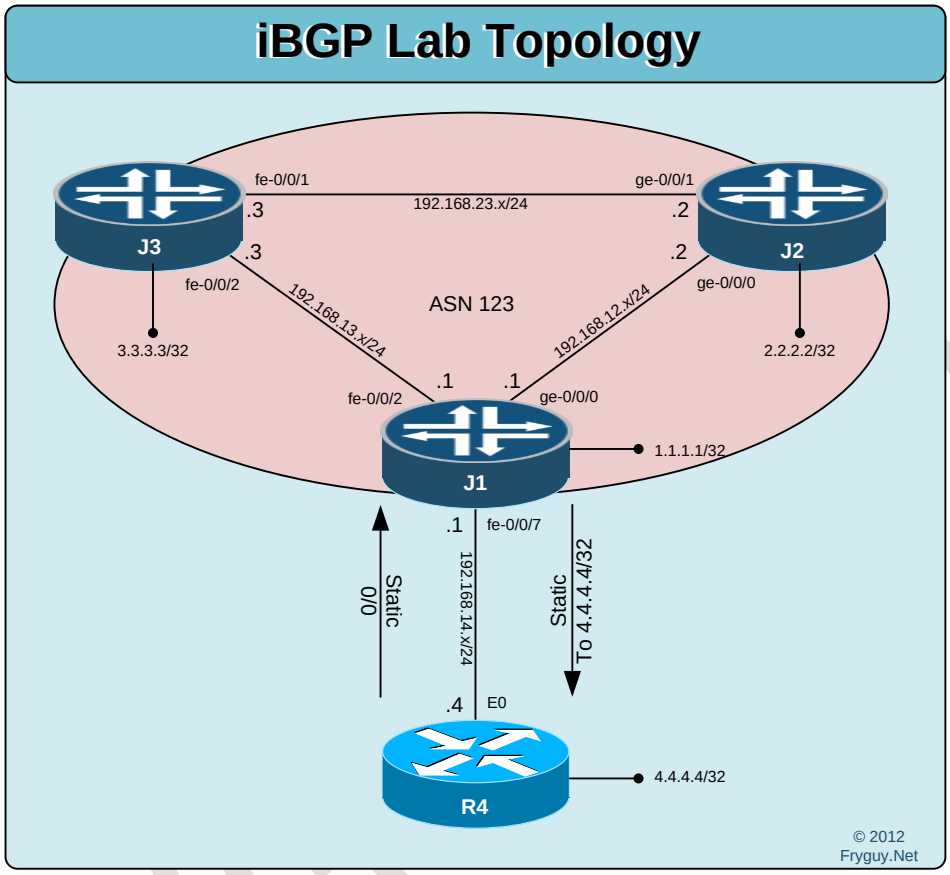
```
              > to 192.168.23.2 via fe-0/0/1.0
3.3.3.3/32        *[Direct/0] 06:21:07
              > via lo0.0
4.4.4.4/32        *[OSPF/150] 00:01:39, metric 2, tag 0
              > to 192.168.13.1 via fe-0/0/2.0
192.168.12.0/24   *[OSPF/10] 00:21:05, metric 2
                   to 192.168.23.2 via fe-0/0/1.0
              > to 192.168.13.1 via fe-0/0/2.0
192.168.13.0/24   *[Direct/0] 06:19:15
              > via fe-0/0/2.0
192.168.13.3/32   *[Local/0] 06:20:41
                   Local via fe-0/0/2.0
192.168.23.0/24   *[Direct/0] 06:18:54
              > via fe-0/0/1.0
192.168.23.3/32   *[Local/0] 06:20:41
                   Local via fe-0/0/1.0
224.0.0.5/32      *[OSPF/10] 06:21:08, metric 1
                   MultiRecv

jfry@J3>
```

And now we can test PING from R3 loopback to R4 loopback:

```
jfry@J3> ping 4.4.4.4 source 3.3.3.3 rapid
PING 4.4.4.4 (4.4.4.4): 56 data bytes
!!!!!
--- 4.4.4.4 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 3.411/8.504/27.947/9.724 ms

jfry@J3>
```

There you have it, OSPF <-> RIP route redistribution!

iBGP



Ok, BGP time. First thing we need to do is rollback all configs to the base. You should be Ok with doing that now on your own, so I will skip documenting that again here. Again, all configs, J1 – J2 – J3 – J4, are all back at their base/rescue level.

Now we need to configure R4 with a static default route to J1 for this lab.

```
R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#ip route 0.0.0.0 0.0.0.0 192.168.14.1
R4(config)#^Z
```

Now we can configure a static route on J1 to R4 4.4.4.4/32

```
[edit]
jfry@J1# set routing-options static route 4.4.4.4/32 next-hop 192.168.14.4 install
[edit]
jfry@J1# commit and-quit
```

And now we can test connectivity to R4 loopback:

```
jfry@J1> ping 4.4.4.4 rapid
PING 4.4.4.4 (4.4.4.4): 56 data bytes
!!!!!
--- 4.4.4.4 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 3.792/3.996/4.149/0.116 ms

jfry@J1>
```

Good! Now we can configure iBGP between J1, J2, and J3 using ASN123. We will peer via the connected interfaces on the routers, and then advertise the loopbacks into BGP.

J1:
Ok, time to define our AS. This is done, like router-id, under the routing-options.

```
[edit]
jfry@J1# set routing-options autonomous-system 123
```

Now we can configure our BGP neighbors. For this we will use a group called ibgp.
This is done under protocols bgp:

```
[edit]
jfry@J1# edit protocols bgp group ibgp
```

We will set this to an internal (ibgp) group:

```
[edit protocols bgp group ibgp]
jfry@J1# set type internal
```

Configure our Peer-as:

```
[edit protocols bgp group ibgp]
jfry@J1# set peer-as 123
```

Then define our neighbors:

```
[edit protocols bgp group ibgp]
jfry@J1# set neighbor 192.168.13.3

[edit protocols bgp group ibgp]
jfry@J1# set neighbor 192.168.12.2
```

Ok, time to head to the top of the stanza and check our config:

```
[edit protocols bgp group ibgp]
jfry@J1# top

[edit]
jfry@J1# show | compare
[edit routing-options]
+   autonomous-system 123;
[edit]
+  protocols {
+      bgp {
+          group ibgp {
+              type internal;
+              peer-as 123;
+              neighbor 192.168.13.3;
+              neighbor 192.168.12.2;
+          }
+      }
+  }

[edit]
jfry@J1#
```

Ok, let's commit it on J1!

```
[edit]
jfry@J1# commit and-quit
commit complete
```

Now onto J2:

```
 [edit]
jfry@J2# set routing-options autonomous-system 123

[edit]
jfry@J2# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J2# set type internal

[edit protocols bgp group ibgp]
jfry@J2# set peer-as 123

[edit protocols bgp group ibgp]
jfry@J2# set neighbor 192.168.12.1

[edit protocols bgp group ibgp]
jfry@J2# set neighbor 192.168.23.3
```

```
[edit protocols bgp group ibgp]
jfry@J2# top

[edit]
jfry@J2# commit and-quit
```

and now J3:

```
[edit]
jfry@J3# set routing-options autonomous-system 123

[edit]
jfry@J3# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J3# set type internal

[edit protocols bgp group ibgp]
jfry@J3# set peer-as 123

[edit protocols bgp group ibgp]
jfry@J3# set neighbor 192.168.13.1

[edit protocols bgp group ibgp]
jfry@J3# set neighbor 192.168.23.2

[edit protocols bgp group ibgp]
jfry@J3# commit and-quit
commit complete
```

Ok, that is J1, J2, and J3 configured for BGP. Time to check our bgp summary:

```
jfry@J1> show bgp summary
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                       0          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.168.12.2           123         11         11       0       0        3:42 0/0/0/0          0/0/0/0
192.168.13.3           123          8          7       0       0        2:23 0/0/0/0          0/0/0/0
```

Ok, J1 looks good. Time to check J2 quick:

```
jfry@J2> show bgp summary
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                       0          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.168.12.1            123         11         12       0       0        4:14 0/0/0/0          0/0/0/0
192.168.23.3            123          8          8       0       0        2:52 0/0/0/0          0/0/0/0

jfry@J2>
```

And J2 has two neighbors.
Ok, let's take a look at the routing table on J2:

```
jfry@J2> show route

inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2.2.2.2/32         *[Direct/0] 00:43:34
                    > via lo0.0
192.168.12.0/24    *[Direct/0] 00:42:38
                    > via ge-0/0/0.0
192.168.12.2/32    *[Local/0] 00:42:42
                      Local via ge-0/0/0.0
192.168.23.0/24    *[Direct/0] 00:42:39
                    > via ge-0/0/1.0
192.168.23.2/32    *[Local/0] 00:42:42
                      Local via ge-0/0/1.0

jfry@J2>
```

Hmm, only local and direct routes. Guess we need to tell BGP what routes it can export to its neighbors! For this lab, we will only advertise loopback addresses from the routers.

First up, J1. (Remember, we also need to advertise R4 loopback)

```
[edit]
jfry@J1# set policy-options prefix-list Loopbacks 1.1.1.1/32

[edit]
jfry@J1# set policy-options prefix-list Loopbacks 4.4.4.4/32

[edit]
jfry@J1# set policy-options policy-statement Advertise term 1 from prefix-list Loopbacks
```

```
[edit]
jfry@J1# set policy-options policy-statement Advertise term 1 then accept

[edit]
jfry@J1# set protocols bgp export Advertise

[edit]
jfry@J1# show | compare
 [edit protocols bgp]
+   export Advertise;
[edit]
+  policy-options {
+      prefix-list Loopbacks {
+          1.1.1.1/32;
+          4.4.4.4/32;
+      }
+      policy-statement Advertise {
+          term 1 {
+              from {
+                  prefix-list Loopbacks;
+              }
+              then accept;
+          }
+      }
+  }

[edit]
jfry@J1# commit and-quit
commit complete
```

Now we do J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# set policy-options prefix-list Loopbacks 2.2.2.2/32

[edit]
jfry@J2# set policy-options policy-statement Advertise term 1 from prefix-list Loopbacks

[edit]
jfry@J2# set policy-options policy-statement Advertise term 1 then accept

[edit]
jfry@J2# set protocols bgp export Advertise
```

```
[edit]
jfry@J2#commit and-quit
```

Now, J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# set protocols bgp export Advertise

[edit]
jfry@J3# set policy-options prefix-list Loopbacks 3.3.3.3/32

[edit]
jfry@J3# set policy-options policy-statement Advertise term 1 from prefix-list Loopbacks

[edit]
jfry@J3# set policy-options policy-statement Advertise term 1 then accept

[edit]
jfry@J3# commit and-quit
```

Now that is all configured, time to look at J2's routing table:

```
jfry@J2> show route

inet.0: 8 destinations, 8 routes (7 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[BGP/170] 00:03:07, localpref 100
                     AS path: I
                   > to 192.168.12.1 via ge-0/0/0.0
2.2.2.2/32         *[Direct/0] 00:51:52
                   > via lo0.0
3.3.3.3/32         *[BGP/170] 00:00:22, localpref 100
                     AS path: I
                   > to 192.168.23.3 via ge-0/0/1.0
192.168.12.0/24    *[Direct/0] 00:50:56
                   > via ge-0/0/0.0
192.168.12.2/32    *[Local/0] 00:51:00
                     Local via ge-0/0/0.0
192.168.23.0/24    *[Direct/0] 00:50:57
                   > via ge-0/0/1.0
192.168.23.2/32    *[Local/0] 00:51:00
                     Local via ge-0/0/1.0

jfry@J2>
```

Hmm, we have a route to all the loopbacks EXCEPT R4. Why?

Well, first we should check to see if R2 is receiving the route. That is done by the command show route receive-protocol bgp *neighbor*

```
jfry@J2> show route receive-protocol bgp 192.168.12.1 all

inet.0: 8 destinations, 8 routes (7 active, 0 holddown, 1 hidden)
  Prefix             Nexthop          MED     Lclpref    AS path
* 1.1.1.1/32         192.168.12.1             100        I
  4.4.4.4/32         192.168.14.4             100        I

__juniper_private1__.inet.0: 7 destinations, 9 routes (7 active, 0 holddown, 0 hidden)

__juniper_private2__.inet.0: 1 destinations, 1 routes (0 active, 0 holddown, 1 hidden)

jfry@J2>
```

We are getting it, so why is it not being installed? Remember, BGP won't install a route if the Nexthop is not in the local routing table – and for us, 192.168.14.4 is listed as the next hop – and we don't have a route for that?

So, how do we overcome this problem? Easy, J1 needs to set itself as the next-hop!
So to do this we will edit our existing Advertise statement and add next-hop self.
J1:

```
jfry@J1# edit policy-options policy-statement Advertise term 1

[edit policy-options policy-statement Advertise term 1]
jfry@J1# set then next-hop self

[edit policy-options policy-statement Advertise term 1]
jfry@J1# commit and-quit
```

Now we can jump back to J2 and check to see if R4 loopback is listed:

```
jfry@J2> show route receive-protocol bgp 192.168.12.1 all

inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
  Prefix             Nexthop          MED     Lclpref    AS path
* 1.1.1.1/32         192.168.12.1             100        I
* 4.4.4.4/32         192.168.12.1             100        I

__juniper_private1__.inet.0: 7 destinations, 9 routes (7 active, 0 holddown, 0 hidden)

__juniper_private2__.inet.0: 1 destinations, 1 routes (0 active, 0 holddown, 1 hidden)

jfry@J2>
```

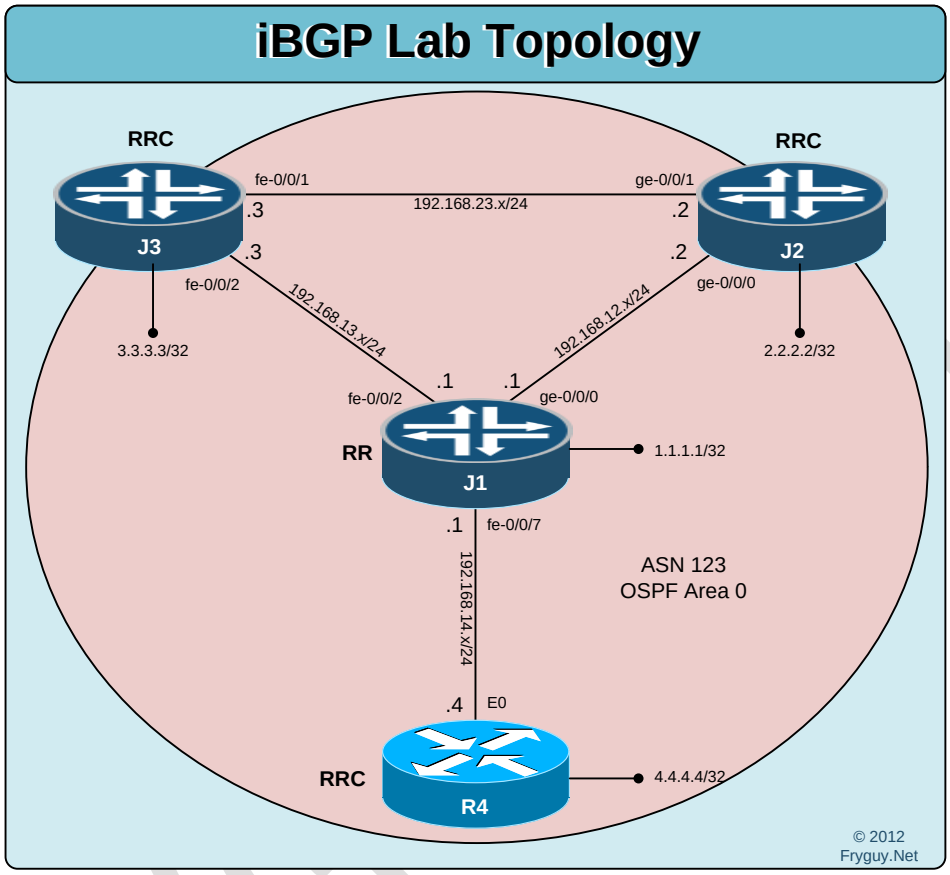
Yup, as you can see the next-hop is now 192.168.12.1

Let’t ping R4 from J2!

```
jfry@J2> ping 4.4.4.4 source 2.2.2.2 rapid
PING 4.4.4.4 (4.4.4.4): 56 data bytes
!!!!!
--- 4.4.4.4 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 3.807/4.195/4.588/0.283 ms

jfry@J2>
```

There we go, we can ping R4 loopback!

iBGP – Route Reflector



Now onto BGP Route-Reflectors. For this lab our IGP will be OSPF, our BGP will be done via the connected interfaces, J1 will be the RR, and we will advertise our loopbacks into BGP.

First though, reset the lab to the rescue config on J1, J2 and J3, and load the base on R4.
Ok, now to configure OSPF and BGP on R4:

```
R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#router ospf 123
R4(config-router)#no au
R4(config-router)#net 192.168.14.0 0.0.0.255 a 0
R4(config-router)#exit
R4(config)#router bgp 123
R4(config-router)#no au
R4(config-router)#nei 192.168.14.1 remote-as 123
R4(config-router)#net 4.4.4.4 mask 255.255.255.255
R4(config-router)#^Z
R4#
```

Will will configure J1 last. So, now for J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# set routing-options autonomous-system 123

[edit]
jfry@J2# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface ge-0/0/0

[edit protocols ospf area 0.0.0.0]
jfry@J2# exit

[edit]
jfry@J2# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J2# set type internal

[edit protocols bgp group ibgp]
jfry@J2# set peer-as 123

[edit protocols bgp group ibgp]
jfry@J2# set neighbor 192.168.12.1

[edit protocols bgp group ibgp]
jfry@J2# top

[edit]
jfry@J2# set policy-options prefix-list Loopbacks 2.2.2.2/32

[edit]
jfry@J2# set policy-options policy-statement Advertise term 1 from prefix-list Loopbacks

[edit]
jfry@J2# set policy-options policy-statement Advertise term 1 then accept

[edit]
jfry@J2# set protocols bgp export Advertise

[edit]
jfry@J2# commit and-quit
```

Now for J3! Entering configuration mode

```
[edit]
jfry@J3# set routing-options autonomous-system 123

[edit]
jfry@J3# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface fe-0/0/2

[edit protocols ospf area 0.0.0.0]
jfry@J3# exit

[edit]
jfry@J3# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J3# set type internal

[edit protocols bgp group ibgp]
jfry@J3# set peer-as 123

[edit protocols bgp group ibgp]
jfry@J3# set neighbor 192.168.13.1

[edit protocols bgp group ibgp]
jfry@J3# top

[edit]
jfry@J3# set policy-options prefix-list Loopbacks 3.3.3.3/32

[edit]
jfry@J3# set policy-options policy-statement Advertise term 1 from prefix-list Loopbacks

[edit]
jfry@J3# set policy-options policy-statement Advertise term 1 then accept

[edit]
jfry@J3# set protocols bgp export Advertise

[edit]
jfry@J3# show | compare
[edit]
+  routing-options {
+      autonomous-system 123;
+  }
+  protocols {
```

```
+     bgp {
+       export Advertise;
+       group ibgp {
+         type internal;
+         peer-as 123;
+         neighbor 192.168.13.1;
+       }
+     }
+     ospf {
+       area 0.0.0.0 {
+         interface fe-0/0/2.0;
+       }
+     }
+ }
+ policy-options {
+     prefix-list Loopbacks {
+       3.3.3.3/32;
+     }
+     policy-statement Advertise {
+       term 1 {
+         from {
+           prefix-list Loopbacks;
+         }
+         then accept;
+       }
+     }
+ }
```

And now for J1!

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# set routing-options autonomous-system 123

[edit]
jfry@J1# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface ge-0/0/0

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface fe-0/0/2

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface fe-0/0/7
```

```
[edit protocols ospf area 0.0.0.0]
jfry@J1# top

[edit]
jfry@J1# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J1# set type internal

[edit protocols bgp group ibgp]
jfry@J1# set peer-as 123
```

Here is where tell J1 that it is a Route-Reflector and what clients are associated with it.

```
[edit protocols bgp group ibgp]
jfry@J1# set cluster 1.1.1.1

[edit protocols bgp group ibgp]
jfry@J1# set neighbor 192.168.13.3

[edit protocols bgp group ibgp]
jfry@J1# set neighbor 192.168.12.2

[edit protocols bgp group ibgp]
jfry@J1# set neighbor 192.168.14.4

[edit protocols bgp group ibgp]
jfry@J1# top

[edit]
jfry@J1# set policy-options prefix-list Loopbacks 1.1.1.1/32

[edit]
jfry@J1# set policy-statement Advertise term 1 from prefix-list Loopbacks

[edit]
jfry@J1# set policy-options policy-statement Advertise term 1 then accept

[edit]
jfry@J1# set protocols bgp export Advertise
```

Ok, let's look at the whole config now for this:

```
[edit]
jfry@J1# show | compare
[edit]
+  routing-options {
+      autonomous-system 123;
+  }
+  protocols {
+      bgp {
+          export Advertise;
+          group ibgp {
+              type internal;
+              cluster 1.1.1.1;
+              peer-as 123;
+              neighbor 192.168.13.3;
+              neighbor 192.168.12.2;
+              neighbor 192.168.14.4;
+          }
+      }
+      ospf {
+          area 0.0.0.0 {
+              interface ge-0/0/0.0;
+              interface fe-0/0/2.0;
+              interface fe-0/0/7.0;
+          }
+      }
+  }
+  policy-options {
+      prefix-list Loopbacks {
+          1.1.1.1/32;
+      }
+      policy-statement Advertise {
+          term 1 {
+              from {
+                  prefix-list Loopbacks;
+              }
+              then accept;
+          }
+      }
+  }

[edit]
jfry@J1# commit and-quit
```

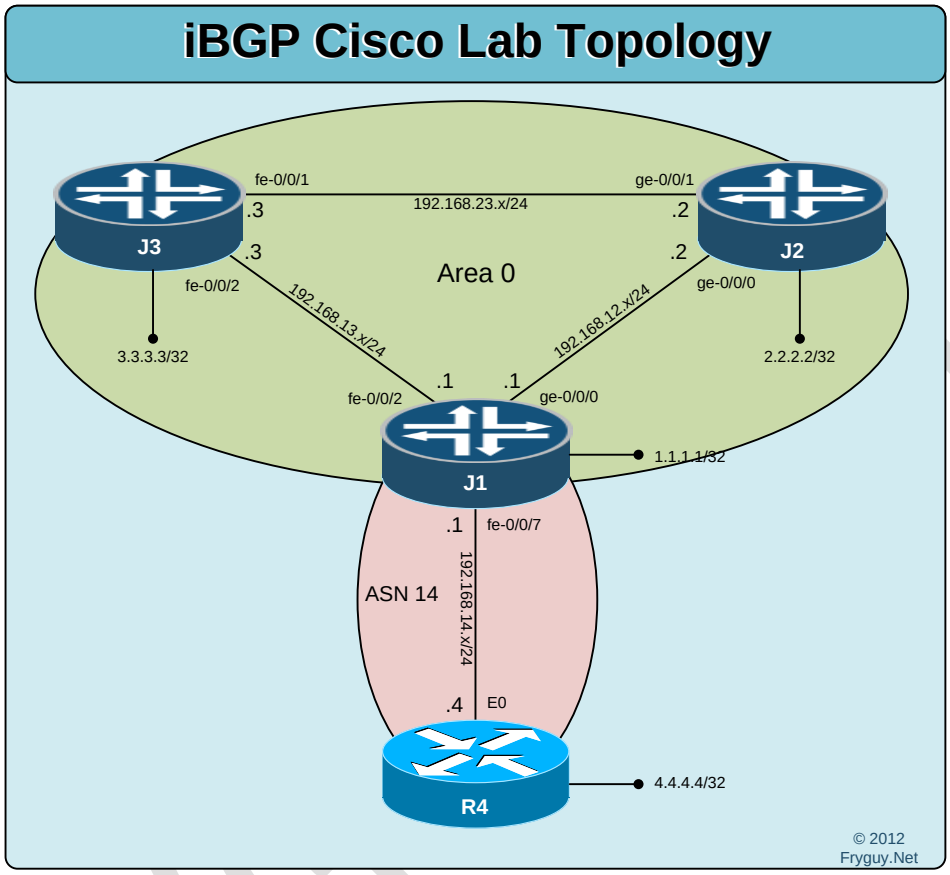
Ok, all that is now configure. Let's hop back to R4 and look at our BGP:

```
R4#sh ip bgp
BGP table version is 5, local router ID is 4.4.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i1.1.1.1/32       192.168.14.1             100      0 i
*>i2.2.2.2/32       192.168.12.2             100      0 i
*>i3.3.3.3/32       192.168.13.3             100      0 i
*> 4.4.4.4/32       0.0.0.0                  0        32768 i
R4#
```

Cool! We have all the loopbacks in BGP. Time to see if R4 can ping the other loopbacks!

```
R4#p 2.2.2.2 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
R4#p 3.3.3.3 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/8 ms
R4#ping 1.1.1.1 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
R4#
```

iBGP – Juniper and Cisco



Ok, again we need to reset the lab to the rescue config on J1, J2 and J3, and load the base on R4.

Now that you have done that, we can configure OSPF area 0 on J1, J2, and J3. We will advertise the loopbacks into OSPF as well.

J1:

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface ge-0/0/0

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface fe-0/0/2
```

```
[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface lo0 passive

[edit protocols ospf area 0.0.0.0]
jfry@J1# commit and-quit
```

Now J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface ge-0/0/0

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface ge-0/0/1

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface lo0 passive

[edit protocols ospf area 0.0.0.0]
jfry@J2# commit and-quit
```

and J3:

```
[edit]
jfry@J3# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface fe-0/0/1

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface fe-0/0/2

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface lo0 passive

[edit protocols ospf area 0.0.0.0]
jfry@J3# commit and-quit
```

Ok, time to check the route table on J1 to make sure all is looking good:

```
jfry@J1> show route | match OSPF
2.2.2.2/32         *[OSPF/10] 00:02:18, metric 1
3.3.3.3/32         *[OSPF/10] 00:02:40, metric 1
192.168.23.0/24    *[OSPF/10] 00:02:02, metric 2
224.0.0.5/32       *[OSPF/10] 00:03:32, metric 1

jfry@J1>
```

Good, we have the right OSPF routes.

Now to configure BGP between J1 and R4:
R4:

```
R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#router bgp 14
R4(config-router)#no au
R4(config-router)#net 4.4.4.4 mask 255.255.255.255
R4(config-router)#nei 192.168.14.1 remote-as 14
R4(config-router)#^Z
R4#
```

and now J1:

```
[edit]
jfry@J1# set routing-options autonomous-system 14

[edit]
jfry@J1# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J1# set type internal

[edit protocols bgp group ibgp]
jfry@J1# set peer-as 14

[edit protocols bgp group ibgp]
jfry@J1# set neighbor 192.168.14.4

[edit protocols bgp group ibgp]
jfry@J1# commit and-quit
```

Now we can check J1 for a route in BGP to R4's loopback:

```
jfry@J1> show route | match BGP
4.4.4.4/32         *[BGP/170] 00:00:33, MED 0, localpref 100

jfry@J1>
```

Excellent! Now we should be able to PING from R1 to R4 loopback:

```
jfry@J1> ping 4.4.4.4 rapid
PING 4.4.4.4 (4.4.4.4): 56 data bytes
!!!!!
--- 4.4.4.4 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 4.063/10.586/20.208/7.804 ms
```

Good, now we need to redistribute on J1 between OSPF and BGP to get full reachability. First up we need to configure a policy to allow OSPF into BGP

```
[edit]
jfry@J1# set policy-options policy-statement OSPF-to-BGP term 1 from protocol ospf area 0

[edit]
jfry@J1# set policy-options policy-statement OSPF-to-BGP term 1 then accept
```

And our directly attached interfaces:

```
[edit]
jfry@J1# set policy-options policy-statement OSPF-to-BGP term 2 from protocol direct

[edit]
jfry@J1# set policy-options policy-statement OSPF-to-BGP term 2 then accept
```

Now we can export that statement to BGP:

```
[edit]
jfry@J1# set protocols bgp export OSPF-to-BGP

[edit]
jfry@J1# commit
commit complete
```

Ok, that should get us a full routing table on R4. Let's check:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

B    192.168.12.0/24 [200/0] via 192.168.14.1, 00:07:33
     1.0.0.0/32 is subnetted, 1 subnets
B       1.1.1.1 [200/0] via 192.168.14.1, 00:07:33
```

```
B    192.168.13.0/24 [200/0] via 192.168.14.1, 00:07:33
     2.0.0.0/32 is subnetted, 1 subnets
B       2.2.2.2 [200/1] via 192.168.12.2, 00:07:33
C    192.168.14.0/24 is directly connected, Ethernet0
     3.0.0.0/32 is subnetted, 1 subnets
B       3.3.3.3 [200/1] via 192.168.13.3, 00:07:33
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
B    192.168.23.0/24 [200/2] via 192.168.13.3, 00:07:34
R4#
```

Now let's get the BGP routes into OSPF:
Configure our policy to allow routes learned from BGP

```
[edit]
jfry@J1# set policy-options policy-statement BGP-to-OSPF term 1 from protocol bgp

[edit]
jfry@J1# set policy-options policy-statement BGP-to-OSPF term 1 then accept
```

And then export those routes to OSPF:

```
[edit]
jfry@J1# set protocols ospf export BGP-to-OSPF

[edit]
jfry@J1# commit
```

And now we can look at J2:

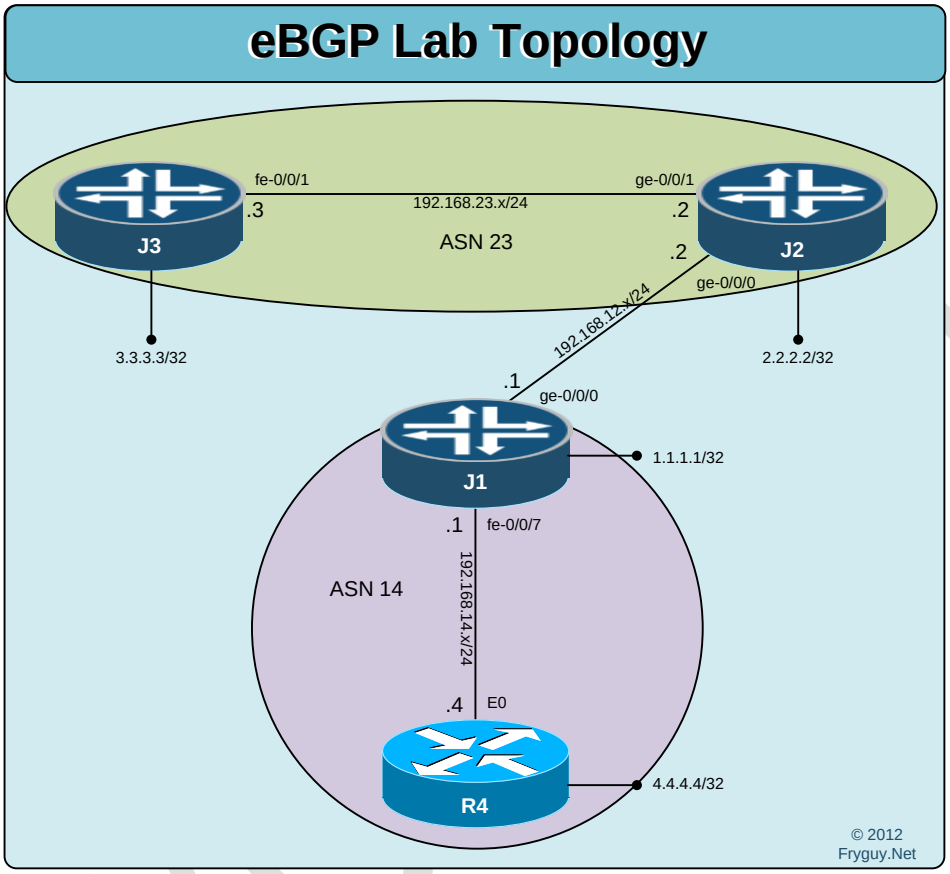
```
jfry@J2> show route | match OSPF
1.1.1.1/32         *[OSPF/10] 00:40:51, metric 1
3.3.3.3/32         *[OSPF/10] 00:40:36, metric 1
4.4.4.4/32         *[OSPF/150] 00:02:09, metric 0, tag 0
192.168.13.0/24    *[OSPF/10] 00:40:36, metric 2
224.0.0.5/32       *[OSPF/10] 00:41:42, metric 1

jfry@J2>
```

Great!
Now let's see if J2 can ping R4 loopback:

```
jfry@J2> ping 4.4.4.4 source 2.2.2.2 rapid
PING 4.4.4.4 (4.4.4.4): 56 data bytes
!!!!!
--- 4.4.4.4 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 3.883/4.075/4.305/0.145 ms
```

There you go, we have connectivity!

eBGP - Juniper to Juniper



Ok, time for some eBGP configurations. Of course, first thing we need to do – reset to the rescue/base configs. You can do that now.

We will create an iBGP session between J1 and R4 using ASN 14 and we will also create an iBGP session between J2 and J3 using ASN 23.

R4 up first:

```
R4(config)#router bgp 14
R4(config-router)#nei 192.168.14.1 remote-as 14
R4(config-router)#nei 192.168.14.1 soft-reconfiguration inbound
R4(config-router)#net 4.4.4.4 mask 255.255.255.255
R4(config-router)#^Z
R4#
```

Now onto J1:

```
[edit]
jfry@J1# set routing-options autonomous-system 14
```

Create our prefix list to advertise our Loopback address:

```
[edit]
jfry@J1# set policy-options prefix-list Loopback 1.1.1.1/32
```

Create our policy to permit the loopbackL

```
[edit]
jfry@J1# set policy-options policy-statement ibgp term 1 from prefix-list Loopback

[edit]
jfry@J1# set policy-options policy-statement ibgp term 1 then accept
```

Now configure our iBGP peering:

```
[edit]
jfry@J1# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J1# set type internal

[edit protocols bgp group ibgp]
jfry@J1# set peer-as 14

[edit protocols bgp group ibgp]
jfry@J1# set neighbor 192.168.14.4
```

And finally what we are going to Export to BGP:

```
[edit protocols bgp group ibgp]
jfry@J1# set export ibgp

[edit protocols bgp group ibgp]
jfry@J1# show
type internal;
export ibgp;
peer-as 14;
neighbor 192.168.14.4;

[edit protocols bgp group ibgp]
jfry@J1# commit and-quit
commit complete
Exiting configuration mode

jfry@J1>
```

Quick check on R4:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
B       1.1.1.1 [200/0] via 192.168.14.1, 00:02:05
C    192.168.14.0/24 is directly connected, Ethernet0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
R4#ping 1.1.1.1 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/8 ms
R4#
```

Good, now onto J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# set routing-options autonomous-system 23

[edit]
jfry@J2# set policy-options prefix-list Loopback 2.2.2.2/32

[edit]
jfry@J2# set policy-options policy-statement ibgp term 1 from prefix-list Loopback

[edit]
jfry@J2# set policy-options policy-statement ibgp term 1 then accept

[edit]
jfry@J2# edit protocols bgp group ibgp
```

```
[edit protocols bgp group ibgp]
jfry@J2# set type internal

[edit protocols bgp group ibgp]
jfry@J2# set peer-as 23

[edit protocols bgp group ibgp]
jfry@J2# set neighbor 192.168.23.3

[edit protocols bgp group ibgp]
jfry@J2# set export ibgp

[edit protocols bgp group ibgp]
jfry@J2# commit and-quit
jfry@J2>
```

and finally J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# set routing-options autonomous-system 23

[edit]
jfry@J3# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J3# set type internal

[edit protocols bgp group ibgp]
jfry@J3# set peer-as 23

[edit protocols bgp group ibgp]
jfry@J3# set neighbor 192.168.23.2

[edit protocols bgp group ibgp]
jfry@J3# set export Loopback

[edit protocols bgp group ibgp]
jfry@J3# top

[edit]
jfry@J3# set policy-options prefix-list Loobacks 3.3.3.3/32

[edit]
jfry@J3# set policy-options policy-statement ibgp term 1 from prefix-list Loopbacks
```

```
[edit]
jfry@J3# set policy-options policy-statement ibgp term 1 then accept

[edit]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode
```

All good!

Back to J2 to see what BGP and routing looks like:

```
jfry@J2> show bgp summary
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                       1          1          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.168.23.3            23         27         26       0       0       10:29 1/1/1/0              0/0/0/0

jfry@J2>
```

And now to PING:

```
jfry@J2> ping 3.3.3.3 source 2.2.2.2 rapid
PING 3.3.3.3 (3.3.3.3): 56 data bytes
!!!!!
--- 3.3.3.3 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 2.424/2.734/3.358/0.345 ms

jfry@J2>
```

Great, we have iBGP working between J2 and J3 as well as J1 and R4. Now we can move onto eBGP!

J1 up first!
We will create a new policy-statement called ebgp and advertise our loopbacks

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# set policy-options policy-statement ebgp term 1 from prefix-list Loopback

[edit]
jfry@J1# set policy-options policy-statement ebgp term 1 then accept
```

Now we will create a new bgp group and call it ebgp
[edit]
jfry@J1# edit protocols bgp group ebgp

Set the type to External
[edit protocols bgp group ebgp]
jfry@J1# set type external

Set the peer-as for ASN23
[edit protocols bgp group ebgp]
jfry@J1# set peer-as 23

Identify our neighbor:
[edit protocols bgp group ebgp]
jfry@J1# set neighbor 192.168.12.2

And then set our export policy:
[edit protocols bgp group ebgp]
jfry@J1# set export ebgp

[edit protocols bgp group ebgp]
jfry@J1# commit and-quit

And now for J2:
[edit]
jfry@J2# set policy-options policy-statement ebgp term 1 from prefix-list Loopback

[edit]
jfry@J2# set policy-options policy-statement ebgp term 1 then accept

[edit]
jfry@J2# edit protocols bgp group ebgp

[edit]
jfry@J2# set type external

[edit]
jfry@J2# set peer-as 14

[edit]
jfry@J2# set neighbor 192.168.12.1

[edit]
jfry@J2# set export ebgp

```
[edit]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode
```

There, all done. Time to check J2 to see if we neighbored up:

```
jfry@J2> show bgp summary
Groups: 2 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                       3          3          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.168.12.1            14          7          8       0       0       2:12 2/2/2/0              0/0/0/0
192.168.23.3            23        147        148       0       0    1:04:32 1/1/1/0              0/0/0/0

jfry@J2>
```

Ok, time to look at the routing table on J2:

```
jfry@J2> show route

inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[BGP/170] 00:04:19, localpref 100
                      AS path: 14 I
                    > to 192.168.12.1 via ge-0/0/0.0
2.2.2.2/32         *[Direct/0] 09:39:16
                    > via lo0.0
3.3.3.3/32         *[BGP/170] 01:06:39, localpref 100
                      AS path: I
                    > to 192.168.23.3 via ge-0/0/1.0
4.4.4.4/32         *[BGP/170] 00:04:19, localpref 100
                      AS path: 14 I
                    > to 192.168.12.1 via ge-0/0/0.0
192.168.12.0/24    *[Direct/0] 09:38:13
                    > via ge-0/0/0.0
192.168.12.2/32    *[Local/0] 09:38:18
                      Local via ge-0/0/0.0
192.168.23.0/24    *[Direct/0] 09:38:14
                    > via ge-0/0/1.0
192.168.23.2/32    *[Local/0] 09:38:17
                      Local via ge-0/0/1.0

jfry@J2>
```

Good, we have routes there! Let's look at J3

```
jfry@J3> show route

inet.0: 8 destinations, 8 routes (6 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

2.2.2.2/32         *[BGP/170] 01:05:11, localpref 100
                     AS path: I
                   > to 192.168.23.2 via fe-0/0/1.0
3.3.3.3/32         *[Direct/0] 09:38:58
                   > via lo0.0
192.168.13.0/24    *[Direct/0] 09:37:09
                   > via fe-0/0/2.0
192.168.13.3/32    *[Local/0] 09:38:31
                     Local via fe-0/0/2.0
192.168.23.0/24    *[Direct/0] 09:36:44
                   > via fe-0/0/1.0
192.168.23.3/32    *[Local/0] 09:38:32
                     Local via fe-0/0/1.0

jfry@J3>
```

Hmm, we are missing routes to J1 and R4.
Time to check to see what routes R2 is sending us.

```
jfry@J3> show route receive-protocol bgp 192.168.23.2 all

inet.0: 8 destinations, 8 routes (6 active, 0 holddown, 2 hidden)
  Prefix             Nexthop          MED     Lclpref    AS path
  1.1.1.1/32         192.168.12.1                100        14 I
* 2.2.2.2/32         192.168.23.2                100         I
  4.4.4.4/32         192.168.12.1                100        14 I

__juniper_private1__.inet.0: 7 destinations, 9 routes (7 active, 0 holddown, 0 hidden)

__juniper_private2__.inet.0: 1 destinations, 1 routes (0 active, 0 holddown, 1 hidden)

jfry@J3>
```

We are getting them, but wait – the next hop is 192.168.12.1. We don't have a route to that network, ahh.

So, we have two choices here – we can either advertise the 192.168.12.x/24 network OR we can configure J2 with next-hop-self. Let's do the next-hop-self here.

Back to J2:

```
jfry@J2> edit
Entering configuration mode
```

What we are going to do is add a second term (term 2) for all other routes. Term 1 is addressing our loopback, so we don't need to worry about that.

```
[edit]
jfry@J2# set policy-options policy -statement ibgp term 2 then next-hop self

[edit]
jfry@J2# set policy-options policy-statement ibgp term 2 then accept

[edit]
jfry@J2#
```

Ok, quick check on J3 for bgp routes:

```
jfry@J3> show route | match bgp
1.1.1.1/32         *[BGP/170] 00:02:27, localpref 100
2.2.2.2/32         *[BGP/170] 01:12:04, localpref 100
4.4.4.4/32         *[BGP/170] 00:02:27, localpref 100
192.168.12.0/24    *[BGP/170] 00:02:27, localpref 100
                    [BGP/170] 00:02:27, localpref 100

jfry@J3>
```

There they are!

This means that we also need to do this on R1. So let's check R4 received routes from J1:

```
R4#sh ip bgp neighbors 192.168.14.1 received-routes
BGP table version is 31, local router ID is 4.4.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i1.1.1.1/32       192.168.14.1             100      0 i
* i2.2.2.2/32       192.168.12.2             100      0 23 i
* i3.3.3.3/32       192.168.12.2             100      0 23 i

Total number of prefixes 3
R4#
```

Yup, same problem. Our next hop is 192.168.12.2, J2's interface. Let's do the same here and set J1 as next-hop-self.

```
jfry@J1> edit
Entering configuration mode
```

```
[edit]
jfry@J1# set policy-options policy-statement ibgp term 2 then next-hop self

[edit]
jfry@J1# set policy-options policy-statement ibgp term 2 then accept

[edit]
jfry@J1# commit and-quit
```

Now we can check R4 routing table:

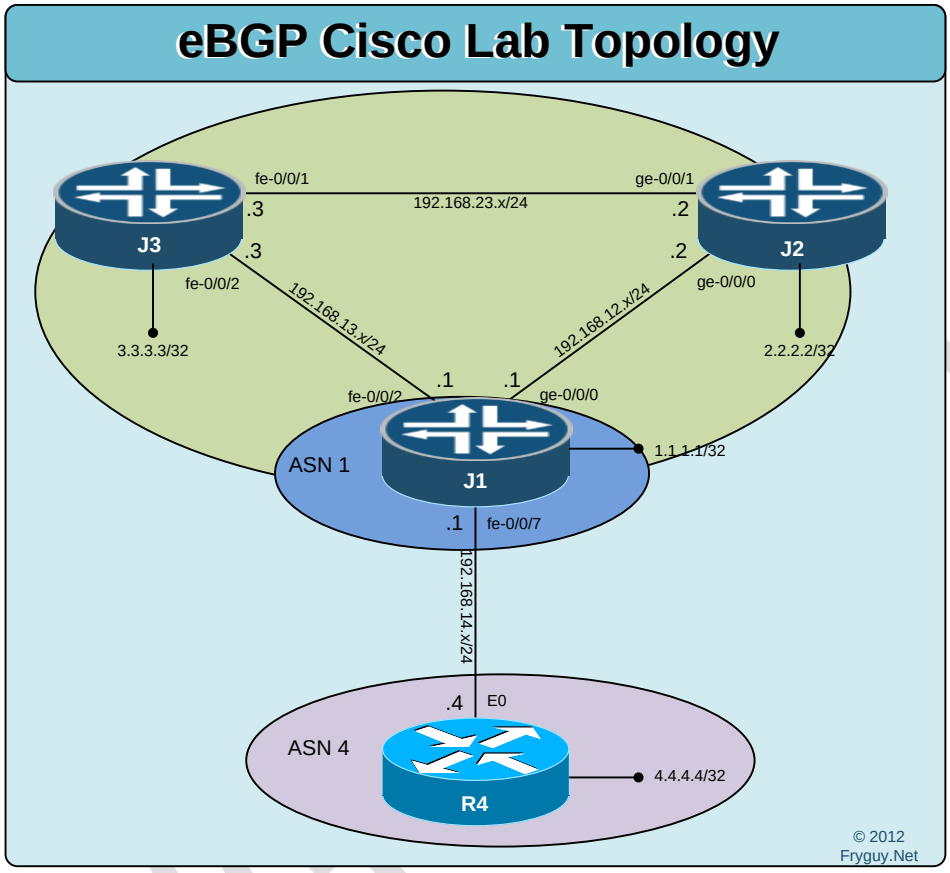
```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

B    192.168.12.0/24 [200/0] via 192.168.14.1, 00:00:49
     1.0.0.0/32 is subnetted, 1 subnets
B       1.1.1.1 [200/0] via 192.168.14.1, 00:53:08
B    192.168.13.0/24 [200/0] via 192.168.14.1, 00:00:49
     2.0.0.0/32 is subnetted, 1 subnets
B       2.2.2.2 [200/0] via 192.168.14.1, 00:00:50
C    192.168.14.0/24 is directly connected, Ethernet0
     3.0.0.0/32 is subnetted, 1 subnets
B       3.3.3.3 [200/0] via 192.168.14.1, 00:00:50
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
R4#
```

And we have all the routes. Time to check R4 loopback to R3 loopback connectivity:

```
R4# ping 3.3.3.3 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
R4#
```

Bingo, it all works!

eBGP – Juniper to Cisco (and some MD5)



Before we begin this lab, reset all the configs back to the rescue/base before beginning.

Ok, let's configure our J1-J2-J3 OSPF Configuration.

J1:

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface ge-0/0/0

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface fe-0/0/2
```

```
[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface lo0 passive

[edit protocols ospf area 0.0.0.0]
jfry@J1# commit and-quit
```

Now, J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface ge-0/0/0

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface ge-0/0/1

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface lo0 passive

[edit protocols ospf area 0.0.0.0]
jfry@J2# commit and-quit
```

And finally, J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface fe-0/0/1

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface fe-0/0/2

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface lo0 passive

[edit protocols ospf area 0.0.0.0]
jfry@J3# commit and-quit
```

Ok, back to J1 to check on the state of our OSPF and routing table
First up, let's check our neighbors:

```
jfry@J1> show ospf neighbor
Address         Interface              State     ID               Pri  Dead
192.168.13.3    fe-0/0/2.0             Full      3.3.3.3          128    38
192.168.12.2    ge-0/0/0.0             Full      2.2.2.2          128    33
```

Good, and now our ospf routing table:

```
jfry@J1> show route protocol ospf

inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2.2.2.2/32         *[OSPF/10] 00:02:21, metric 1
                    > to 192.168.12.2 via ge-0/0/0.0
3.3.3.3/32         *[OSPF/10] 00:01:29, metric 1
                    > to 192.168.13.3 via fe-0/0/2.0
192.168.23.0/24    *[OSPF/10] 00:01:29, metric 2
                    > to 192.168.12.2 via ge-0/0/0.0
                      to 192.168.13.3 via fe-0/0/2.0
224.0.0.5/32       *[OSPF/10] 00:03:52, metric 1
                      MultiRecv

jfry@J1>
```

Looking good. Now we can configure ebgp between J1 and R4:
R4 up first for BGP.

```
R4#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#router bgp 4
R4(config-router)#no au
R4(config-router)#net 4.4.4.4 mask 255.255.255.0
R4(config-router)#nei 192.168.14.1 remote-as 1
R4(config-router)#^Z
R4#
```

Now onto J1 for ebgp
J1:
[edit]
jfry@J1# set routing-options autonomous-system 1

I am going to deviate a bit here on how I have been doing the policies. Now that you should be familiar with the set based way to do it, I will use the edit based way. I will edit my policy statement:
[edit]
jfry@J1# edit policy-options policy-statement ebgp

Then edit my first term to accept OSPF Area 0 routes:
[edit policy-options policy-statement ebgp]
jfry@J1# edit term 1

[edit policy-options policy-statement ebgp term 1]
jfry@J1# set from protocol ospf area 0

[edit policy-options policy-statement ebgp term 1]
jfry@J1# set then accept

Then move up one Stanza in the edit config:
[edit policy-options policy-statement ebgp term 1]
jfry@J1# up

And now edit Term 2 to accept directly connected interfaces:
[edit policy-options policy-statement ebgp]
jfry@J1# edit term 2

[edit policy-options policy-statement ebgp term 2]
jfry@J1# set from protocol direct

[edit policy-options policy-statement ebgp term 2]
jfry@J1# set then accept

[edit policy-options policy-statement ebgp term 2]
jfry@J1# top

Now we will edit our ebgp group like we did in the last lab:
[edit]
jfry@J1# edit protocols bgp group ebgp

[edit protocols bgp group ebgp]
jfry@J1# set type external

[edit protocols bgp group ebgp]
jfry@J1# set peer-as 4

```
[edit protocols bgp group ebgp]
jfry@J1# set neighbor 192.168.14.4

[edit protocols bgp group ebgp]
jfry@J1# set export ebgp

[edit protocols bgp group ebgp]
jfry@J1# commit and-quit
```

Now time to check the bgp neighbors:

```
jfry@J1> show bgp summary
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                       1          1          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.168.14.4             4         15         19       0       0        6:07 1/1/1/0              0/0/0/0

jfry@J1>
```

Good, we are neighbored with R4.
Time to check the routing table on J1:

```
jfry@J1> show route

inet.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[Direct/0] 03:27:14
                    > via lo0.0
2.2.2.2/32         *[OSPF/10] 00:22:15, metric 1
                    > to 192.168.12.2 via ge-0/0/0.0
3.3.3.3/32         *[OSPF/10] 00:21:23, metric 1
                    > to 192.168.13.3 via fe-0/0/2.0
4.4.4.4/32         *[BGP/170] 00:00:48, MED 0, localpref 100
                      AS path: 4 I
                    > to 192.168.14.4 via fe-0/0/7.0
192.168.12.0/24    *[Direct/0] 03:26:03
                    > via ge-0/0/0.0
192.168.12.1/32    *[Local/0] 03:26:33
                      Local via ge-0/0/0.0
192.168.13.0/24    *[Direct/0] 03:26:28
                    > via fe-0/0/2.0
192.168.13.1/32    *[Local/0] 03:26:32
                      Local via fe-0/0/2.0
192.168.14.0/24    *[Direct/0] 03:26:28
                    > via fe-0/0/7.0
192.168.14.1/32    *[Local/0] 03:26:32
```

```
                Local via fe-0/0/7.0
192.168.23.0/24    *[OSPF/10] 00:21:23, metric 2
                  > to 192.168.12.2 via ge-0/0/0.0
                    to 192.168.13.3 via fe-0/0/2.0
224.0.0.5/32       *[OSPF/10] 00:23:46, metric 1
                    MultiRecv

jfry@J1>
```

Good, now to check R4:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

B    192.168.12.0/24 [20/0] via 192.168.14.1, 00:06:52
     1.0.0.0/32 is subnetted, 1 subnets
B       1.1.1.1 [20/0] via 192.168.14.1, 00:06:52
B    192.168.13.0/24 [20/0] via 192.168.14.1, 00:06:52
     2.0.0.0/32 is subnetted, 1 subnets
B       2.2.2.2 [20/1] via 192.168.14.1, 00:06:52
C    192.168.14.0/24 is directly connected, Ethernet0
     3.0.0.0/32 is subnetted, 1 subnets
B       3.3.3.3 [20/1] via 192.168.14.1, 00:06:52
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
B    192.168.23.0/24 [20/2] via 192.168.14.1, 00:06:52
R4#
```

Cool both routers have all the routes. Now, time to check if R4 can PING J1 loopback:

```
R4# ping 1.1.1.1 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
R4#
```

Good, how about J2 loopback:

```
R4#ping 2.2.2.2 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
.....
Success rate is 0 percent (0/5)
R4#
```

Nope, why is this? Let's check J2 routing table:

```
jfry@J2> show route

inet.0: 9 destinations, 9 routes (9 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[OSPF/10] 00:24:37, metric 1
                    > to 192.168.12.1 via ge-0/0/0.0
2.2.2.2/32         *[Direct/0] 03:29:29
                    > via lo0.0
3.3.3.3/32         *[OSPF/10] 00:23:43, metric 1
                    > to 192.168.23.3 via ge-0/0/1.0
192.168.12.0/24    *[Direct/0] 03:28:25
                    > via ge-0/0/0.0
192.168.12.2/32    *[Local/0] 03:28:31
                      Local via ge-0/0/0.0
192.168.13.0/24    *[OSPF/10] 00:23:43, metric 2
                      to 192.168.12.1 via ge-0/0/0.0
                    > to 192.168.23.3 via ge-0/0/1.0
192.168.23.0/24    *[Direct/0] 03:28:26
                    > via ge-0/0/1.0
192.168.23.2/32    *[Local/0] 03:28:30
                      Local via ge-0/0/1.0
224.0.0.5/32       *[OSPF/10] 00:24:47, metric 1
                      MultiRecv

jfry@J2>
```

Hmm, no route. Why? Well, it is because we did not redistribute routes from BGP to OSPF on J1. ☺

Time to configure that on J1:

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# edit policy-options policy-statement ospf
```

```
[edit policy-options policy-statement ospf]
jfry@J1# edit term 1

[edit policy-options policy-statement ospf term 1]
jfry@J1# set from protocol bgp

[edit policy-options policy-statement ospf term 1]
jfry@J1# set then accept

[edit policy-options policy-statement ospf term 1]
jfry@J1# top

[edit]
jfry@J1# edit protocols ospf

[edit protocols ospf]
jfry@J1# set export ospf

 [edit protocols ospf]
jfry@J1# commit and-quit
```

Ok, time to check the routing table on J2:

```
jfry@J2> show route protocol ospf

inet.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[OSPF/10] 00:31:25, metric 1
                  > to 192.168.12.1 via ge-0/0/0.0
3.3.3.3/32         *[OSPF/10] 00:30:31, metric 1
                  > to 192.168.23.3 via ge-0/0/1.0
4.4.4.4/32         *[OSPF/150] 00:02:12, metric 0, tag 0
                  > to 192.168.12.1 via ge-0/0/0.0
192.168.13.0/24    *[OSPF/10] 00:30:31, metric 2
                    to 192.168.12.1 via ge-0/0/0.0
                  > to 192.168.23.3 via ge-0/0/1.0
224.0.0.5/32       *[OSPF/10] 00:31:35, metric 1
                    MultiRecv
```

Good, now we can retest R4 ping to J2:

```
R4#ping 2.2.2.2 so l0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 4.4.4.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/6/20 ms
```

Ok, now to MD5 Auth between J1 and R4 for good measure.

R4 first:

```
R4(config)#nei
R4(config)#router bgp 4
R4(config-router)#neighbor 192.168.14.1 password 0 JunosIOS
```

And now J1:

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# edit protocols bgp group ebgp
```

Authentication is configured under the neighbor:

```
[edit protocols bgp group ebgp]
jfry@J1# edit neighbor 192.168.14.4
```

And now we configure the password:

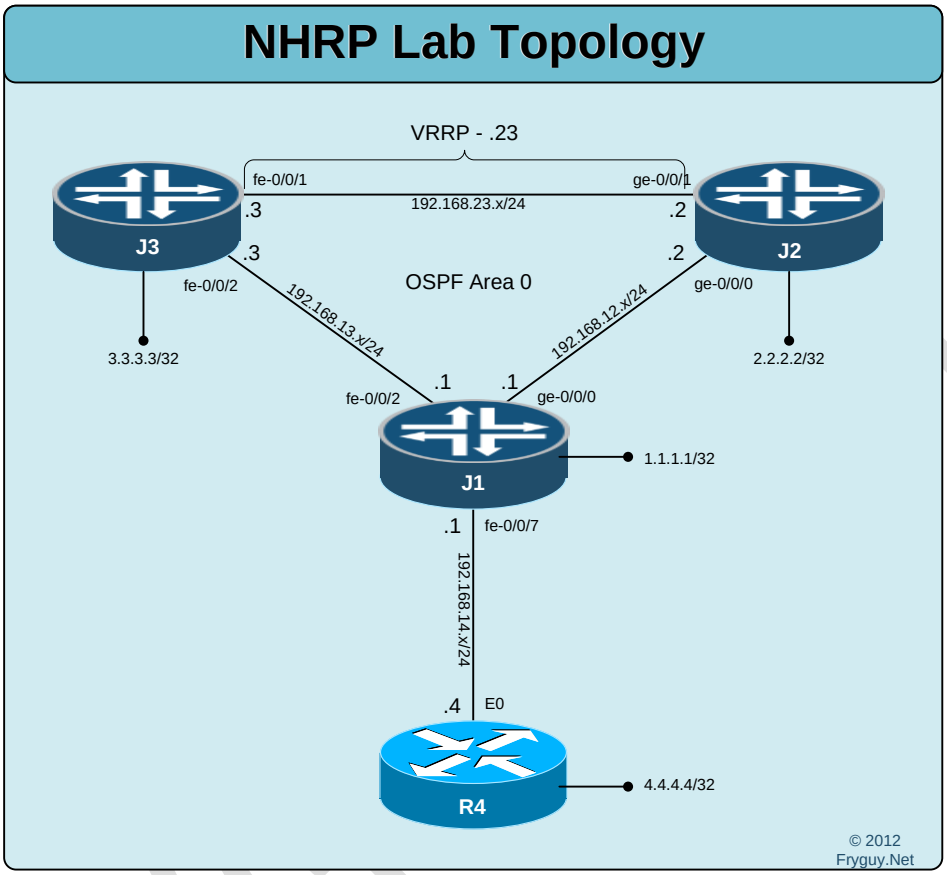
```
[edit protocols bgp group ebgp neighbor 192.168.14.4]
jfry@J1# set authentication-key JunosIOS

[edit protocols bgp group ebgp neighbor 192.168.14.4]
jfry@J1# commit and-quit
commit complete
Exiting configuration mode

jfry@J1
```

Ok, We should have a bgp neighbor now:

```
jfry@J1> show bgp neighbor 192.168.14.4
Peer: 192.168.14.4+11005 AS 4  Local: 192.168.14.1+179 AS 1
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ ebgp ]
  Options: <Preference AuthKey PeerAS Refresh>
  Authentication key is configured
```

There we go, BGP authentication!

NHRP



Before beginning, reset all configs back to rescue/base.

Junos only supports the standard NHRP, VRRP. For this lab we will configure a VRRP address of 192.168.23.23 on the link between J2 and J3. We will then PING that address from R4 to validate traffic. In order to test failover, we will deactivate an interface on J2 (Master VRRP) and check that J3 is now the active VRRP device.

Ok, basics first – let's get OSPF configured on this network.
R4:

```
R4(config)#router ospf 1
R4(config-router)#no au
R4(config-router)#net 0.0.0.0 255.255.255.255 a 0
R4(config-router)#^Z
```

Now onto J1:

```
[edit]
jfry@J1# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface fe-0/0/7

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface ge-0/0/0

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface fe-0/0/2

[edit protocols ospf area 0.0.0.0]
jfry@J1# set interface lo0 passive

[edit protocols ospf area 0.0.0.0]
jfry@J1# commit and-quit
```

Now J2:

```
[edit]
jfry@J2# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface ge-0/0/0

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface ge-0/0/1

[edit protocols ospf area 0.0.0.0]
jfry@J2# set interface lo0 passive

[edit protocols ospf area 0.0.0.0]
jfry@J2# commit and-quit
```

And J3:

```
[edit]
jfry@J3# edit protocols ospf area 0

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface fe-0/0/1

[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface fe-0/0/2
```

```
[edit protocols ospf area 0.0.0.0]
jfry@J3# set interface lo0 passive

[edit protocols ospf area 0.0.0.0]
jfry@J3# commit and-quit
```

Ok, time to test ping from J3 to R4:

```
jfry@J3> ping 4.4.4.4 source 3.3.3.3 rapid
PING 4.4.4.4 (4.4.4.4): 56 data bytes
!!!!!
--- 4.4.4.4 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 3.052/3.154/3.334/0.110 ms

jfry@J3>
```

Good, now for VRRP. J2 up first since that will be the master.
For J2 I will use all set based commands from the top, and for J3 I will navigate to the interface.

First we will define our VRRP address of 192.168.23.23

```
[edit]
jfry@J2# set interface ge-0/0/1 unit 0 family inet address 192.168.23.2/24 vrrp-group 1 virtual-address
192.168.23.23
```

Now we will configure a higher priority to make sure we are the master:

```
[edit]
jfry@J2# set interface ge-0/0/1 unit 0 family inet address 192.168.23.2/24 vrrp-group 1 priority 150
```

We will configure preempt to make sure we are always the master:

```
[edit]
jfry@J2# set interface ge-0/0/1 unit 0 family inet address 192.168.23.2/24 vrrp-group 1 preempt
```

And finally we need to tell Junos that we will respond to that address via ICMP and SNMP:

```
[edit]
jfry@J2# set interface ge-0/0/1 unit 0 family inet address 192.168.23.2/24 vrrp-group 1 accept-data

[edit]
jfry@J2# commit and-quit
```

Ok, let us check it quick and make sure we are master:

```
jfry@J2> show vrrp
Interface     State       Group   VR state VR Mode   Timer    Type   Address
ge-0/0/1.0    up              1   master   Active       A  0.495 lcl    192.168.23.2
                                                                vip    192.168.23.23

jfry@J2>
```

Good, we are master!

and now for J3:
jfry@J3> edit
Entering configuration mode

Now we can navigate to the interface:
[edit]
jfry@J3# edit interface fe-0/0/1 unit 0 family inet address 192.168.23.3/24

Good, now we can edit our vrrp-group:
[edit interfaces fe-0/0/1 unit 0 family inet address 192.168.23.3/24]
jfry@J3# edit vrrp-group 1

And now just do the set based commands for VRRP!
[edit interfaces fe-0/0/1 unit 0 family inet address 192.168.23.3/24 vrrp-group 1]
jfry@J3# set virtual-address 192.168.23.23

[edit interfaces fe-0/0/1 unit 0 family inet address 192.168.23.3/24 vrrp-group 1]
jfry@J3# set accept-data

[edit interfaces fe-0/0/1 unit 0 family inet address 192.168.23.3/24 vrrp-group 1]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode

Good, now we can check our VRRP on J3:
jfry@J3> show vrrp

```
Interface     State       Group   VR state VR Mode   Timer    Type   Address
fe-0/0/1.0    up              1   backup   Active       D  3.455 lcl    192.168.23.3
                                                                vip    192.168.23.23
                                                                mas    192.168.23.2
```

jfry@J3>
Good, we are in backup state and 192.168.23.2 is master.

Time to ping from R4:
R4#ping 192.168.23.23

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.23.23, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
R4#

Now we can deactivate the interface on J2 and make J3 active:
[edit]
jfry@J2# deactivate interfaces ge-0/0/1
[edit]
jfry@J2# commit and-quit

And back to J3 to check VRRP status:

```
jfry@J3> show vrrp
Interface     State       Group   VR state VR Mode   Timer    Type   Address
fe-0/0/1.0    up              1   master   Active      A  0.163 lcl    192.168.23.3
                                                               vip    192.168.23.23

jfry@J3>
```

Good, we are master since J2 is now longer active.
Time to ping from R4:

```
R4#ping 192.168.23.23

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.23.23, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/8 ms
R4#
```

And now let's reactivate J2 interface:

```
[edit]
jfry@J2# activate interfaces ge-0/0/1

[edit]
jfry@J2# commit and-quit
```

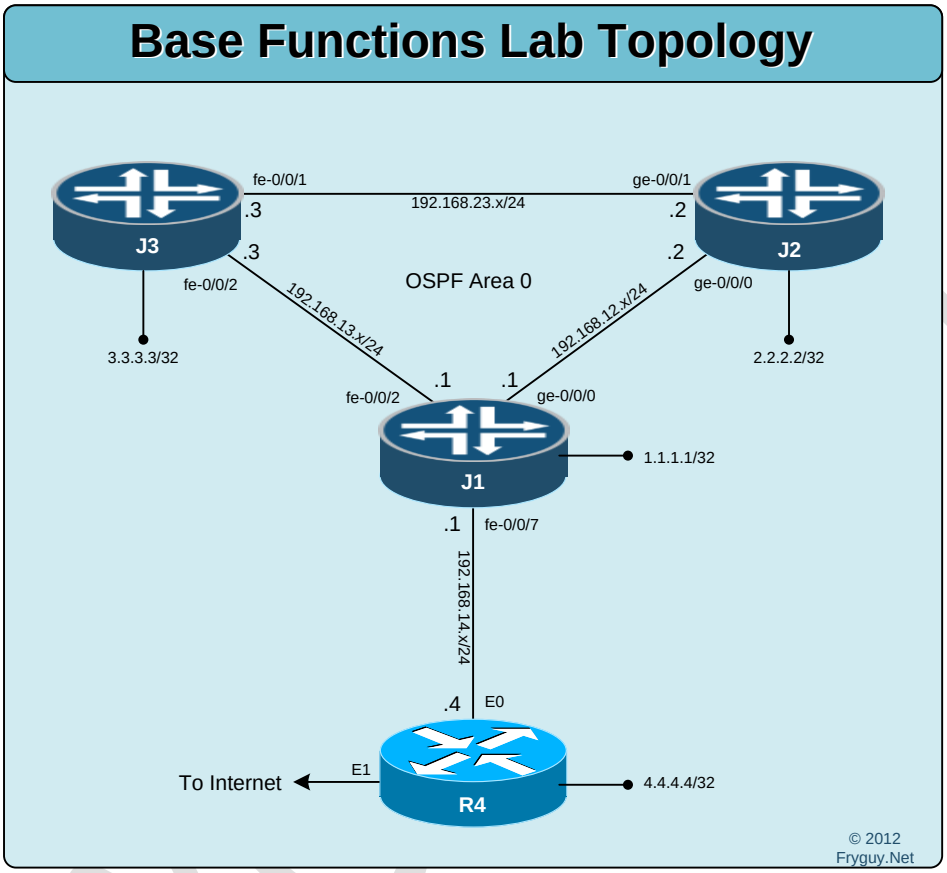
Now J3 should be in backup again and J2 should be master:

```
jfry@J3> show vrrp
Interface     State       Group   VR state VR Mode   Timer    Type   Address
fe-0/0/1.0    up              1   backup   Active      D  2.893 lcl    192.168.23.3
                                                               vip    192.168.23.23
                                                               mas    192.168.23.2

jfry@J3>
```

And that is VRRP in a nutshell!

System Services

NTP – Telnet – SSH – SNMP – Monitor - LAG



There are a few services that I wanted to cover but wanted to wait until near the end. The reason for waiting is that I wanted you to focus on the configuration on the protocols and not so much the access and supporting features. Plus, having an routing protocol configured simplifies the testing of these commands.

For this lab you will need to rollback to the rescue config and then configure OSPF Area 0 on all the routers, configure R4 to connect to the Internet and advertise a default-route to OSPF. Once you have that completed, we will continue on to discuss:

- NTP
- Telnet / SSH Access
- SNMP
- Monitor
- LAG (Link Aggregation Group)

NTP

So, onto configure NTP on your J1, J2, and J3 routers. For this lab, configure your Cisco router in UTC, set it to sync with 198.245.60.153, and finally as a NTP master.

R4:

```
R4(config)#
R4(config)#
R4(config)#clock time
R4(config)#clock timezone UTC -0
R4(config)#ntp server 198.245.60.153
R4(config)#ntp master
```

Now we will configure J1, J2, and J3 to all sync with R4 4.4.4.4 interface for NTP.

First let's see what time it is on J1:

```
jfry@J1> show system uptime
Current time: 2010-09-04 11:01:01 UTC
System booted: 2010-09-04 10:46:02 UTC (00:14:59 ago)
Protocols started: 2010-09-04 10:48:51 UTC (00:12:10 ago)
Last configured: 2012-09-04 23:02:04 UTC (-12:-1:-3 ago) by jfry
11:01AM  up 15 mins, 1 user, load averages: 0.04, 0.50, 0.75

jfry@J1>
```

Ok, its September 4, 2012 at around 11 AM UTC. Now to configure NTP:

```
[edit]
jfry@J1# set system time-zone UTC

[edit]
jfry@J1# set system ntp server 4.4.4.4

[edit]
jfry@J1# commit and-quit
```

Now, time to recheck:

```
jfry@J1> show system uptime
Current time: 2012-09-05 00:43:56 UTC
System booted: 2012-09-05 00:27:35 UTC (00:16:21 ago)
Protocols started: 2012-09-05 00:30:24 UTC (00:13:32 ago)
Last configured: 2010-09-04 11:02:00 UTC (104w3d 13:41 ago) by jfry
12:43AM  up 16 mins, 1 user, load averages: 0.47, 0.49, 0.72
```

And we can check our associations:

```
jfry@J1> show ntp associations
     remote           refid      st t when poll reach   delay   offset  jitter
==============================================================================
 4.4.4.4         .STEP.          16 -  114   64    0    0.000    0.000 4000.00

jfry@J1>
```

Now, lets configure J2 and J3 the same way:
J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# set system time-zone UTC

[edit]
jfry@J2# set system ntp server 4.4.4.4

[edit]
jfry@J2# commit and-quit
```

And finally J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# set system time-zone UTC

[edit]
jfry@J3# set system ntp server 4.4.4.4

[edit]
jfry@J3# commit and-quit
commit complete
```

There is NTP in a nutshell!

Telnet/SSH

Now let's configure Telnet/SSH access to these routers.
Note: I have configured the necessary routes to access this lab from my home network.

Ok, first up time to create a quick banner message to alert the user they are accessing a device:

```
[edit]
jfry@J1# set system login message "Ask yourself, are you allowed to login to this device?"
```

Now we will set a message for after then are authenticated. The \n means New Line, so this will place a new line between the message and the prompt.

```
[edit]
jfry@J1# set system login announcement "Well, I guess so! \n"
```

Now we can enable telnet and SSH

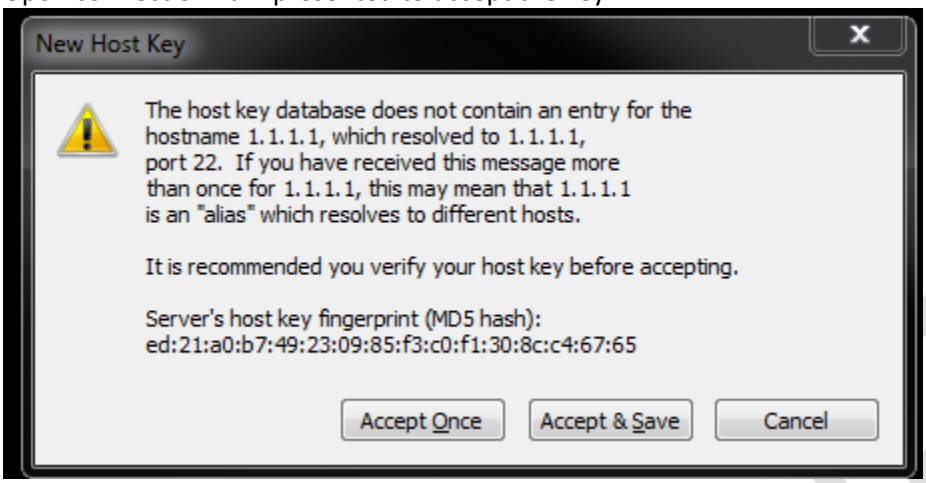
```
[edit]
jfry@J1# set system services telnet

[edit]
jfry@J1# set system services ssh

[edit]
jfry@J1# commit and-quit
```

Now you should notice that it did not tell you that you need to generate a keygen like on Cisco.
That is because the underling FreeBSD, already did that when it was initially installed.

Time to test out Telnet access to J1 from R4:

```
R4#telnet 1.1.1.1
Trying 1.1.1.1 ... Open
Ask yourself, are you allowed to login to this device?

J1 (ttyp1)

login: jfry
Password:

--- JUNOS 12.1R2.9 built 2012-05-31 08:58:52 UTC

It appears so!
jfry@J1>
```

Now we can try SSH from a client – I use Secure CRT:
Upon connection I am presented to accept the key:



Ask yourself, are you allowed to login to this device?
--- JUNOS 12.1R2.9 built 2012-05-31 08:58:52 UTC
It appears so!
jfry@J1>

To keep things consistent, we can add this config to J2 and J3:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# set system message "Ask yourself, are you allowed to login to this device?"

[edit]
jfry@J2# set system login announcement "Well, I guess so! \n"

[edit]
jfry@J2# set system services telnet

[edit]
jfry@J2# set system services ssh

[edit]
jfry@J2# commit and-quit
commit complete
```

and finally J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# set system login announcement "Well, I guess so! \n"
```

```
 [edit]
jfry@J3# set system login message "Ask yourself, are you allowed to login to this device?"

[edit]
jfry@J3# set system services ssh

[edit]
jfry@J3# set system services telnet

[edit]
jfry@J3# commit and-quit
```

Basic SNMP

Ok, time for some basic SNMP stuff.
Since this is all the same across all the devices, we will just focus on J1 from here on out until we get to LAG.

For this one, we will create an SNMP community of fryguy and limit it to the loopback interface.

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# set snmp community fryguy
```

Before we tell it lo0, here is what the interface command options provide you:

```
[edit]
jfry @J1# set snmp interface ?
Possible completions:
  <value>           Restrict SNMP requests to interfaces
  [                 Open a set of values
  lo0.0             Restrict SNMP requests to interfaces
[edit]
jfry @J1# set snmp interface lo0

[edit]
jfry @J1# set snmp contact jeff@fryguy.net

[edit]
jfry @J1# set snmp location Fryguy's Lab
                            ^
                 syntax error.
```

We got an error because of the space, since it has a space it needs to be in " quotes "

```
[edit]
jfry@J1# set snmp location "Fryguy's Lab"
```

```
[edit]
jfry@J1# commit and-quit
```

If you want, you can even MIB walk right from the Junos CLI:

```
jfry@J1> show snmp mib walk 1.3.6
sysDescr.0    = Juniper Networks, Inc. srx210h internet router, kernel JUNOS 12.1R2.9 #0: 2012-05-31
08:58:52 UTC     builder@greteth:/volume/build/junos/12.1/release/12.1R2.9/obj-
octeon/junos/bsd/kernels/JSRXNLE/kernel Build date: 2012-05-31 11:07:04 UTC Copyright (c)
sysObjectID.0 = jnxProductNameSRX210
sysUpTime.0   = 1988441
sysContact.0  = jeff@fryguy.net
sysName.0     = J1
sysLocation.0 = Fryguy's Lab
sysServices.0 = 4
ifNumber.0    = 39
---(more)---[abort]
```

Monitoring

Ok, now onto monitoring.

Say we want to monitor the usage of an interface on J1, the interface facing R4 – fe-0/0/7. We want to see input/output etc.

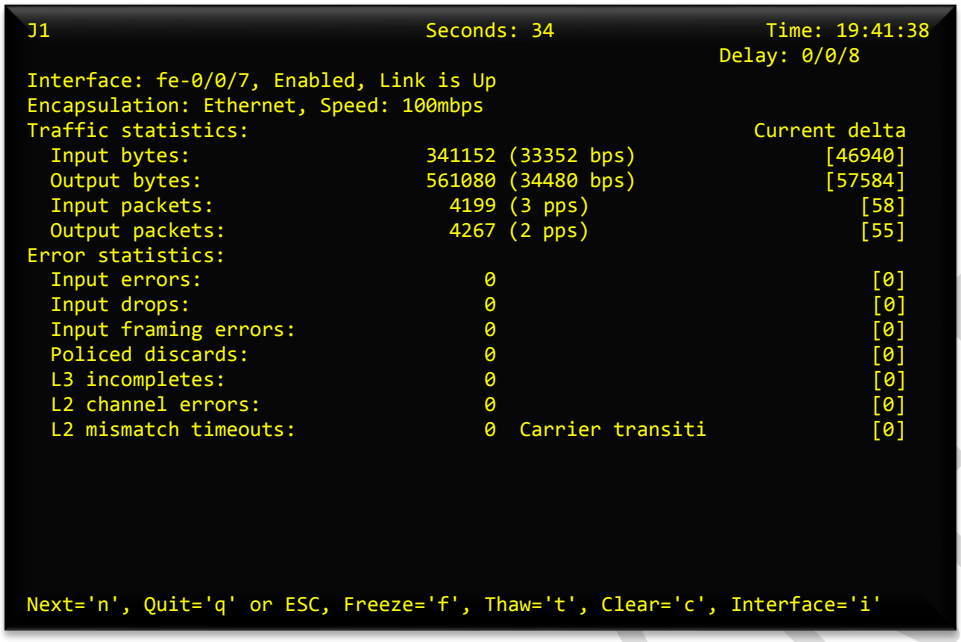
We could do *show interface fe-0/0/7*

```
root@J1> show interfaces fe-0/0/7
Physical interface: fe-0/0/7, Enabled, Physical link is Up
  Interface index: 141, SNMP ifIndex: 518
  Link-level type: Ethernet, MTU: 1514, Link-mode: Full-duplex, Speed: 100mbps,
  BPDU Error: None, MAC-REWRITE Error: None, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0
  CoS queues     : 8 supported, 8 maximum usable queues
  Current address: 00:24:dc:d4:b5:c7, Hardware address: 00:24:dc:d4:b5:c7
  Last flapped   : 2012-09-06 14:00:36 UTC (05:38:10 ago)
  Input rate     : 472 bps (0 pps)
  Output rate    : 472 bps (0 pps)
  Active alarms  : None
  Active defects : None
  Interface transmit statistics: Disabled
```

And then do that again, and again, and again monitoring the delta changes OR we could use the *monitor* command:

```
jfry @J1> monitor interface fe-0/0/7
```

And you will get a screen that will constantly refresh and look like the following:



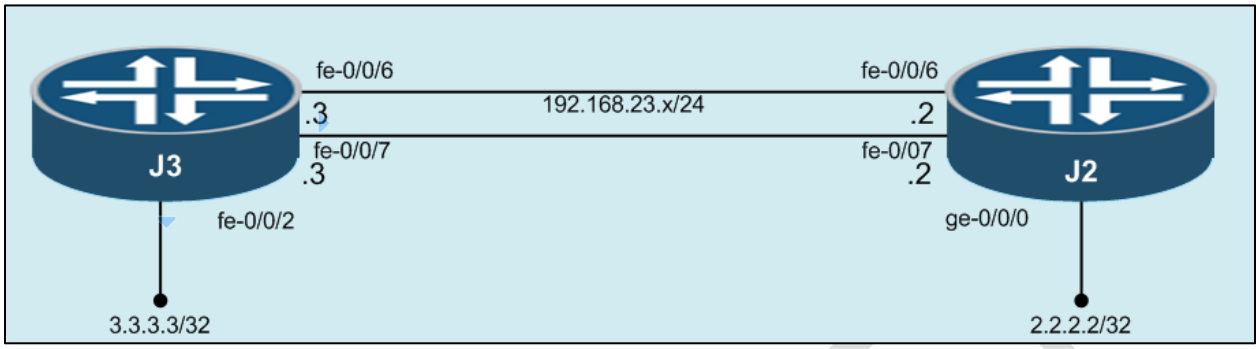
Now what if we want to monitor the actual packets, in other words – sniff the traffic – we can use the command *monitor traffic*

```
jfry@J1> monitor traffic interface fe-0/0/7
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is ON. Use <no-resolve> to avoid any reverse lookup delay.
Address resolution timeout is 4s.
Listening on fe-0/0/7, capture size 96 bytes

Reverse lookup for 192.168.14.1 failed (check DNS reachability).
Other reverse lookup failures will not be reported.
Use <no-resolve> to avoid reverse lookups on IP addresses.

19:46:34.038029 Out IP truncated-ip - 20 bytes missing! 192.168.14.1 > 224.0.0.5: OSPFv2, Hello, length
60
19:46:41.290532  In IP 192.168.14.4 > 224.0.0.5: OSPFv2, Hello, length 60
19:46:42.234807  In 00:11:20:df:84:90 > 01:00:0c:cc:cc:cc SNAP Unnumbered, ui, Flags [Command],
length 60
19:46:42.550634  In IP 192.168.0.28.57575 > 1.1.1.1.telnet: S 908673441:908673441(0) win 8192 <mss
1260,nop,wscale 2,nop,nop,sackOK>
19:46:42.550884 Out IP 1.1.1.1.telnet > 192.168.0.28.57575: S 3451348271:3451348271(0) ack
908673442 win 65535 <mss 1460,nop,wscale 1,sackOK,eol>
19:46:42.553560  In IP 192.168.0.28.57575 > 1.1.1.1.telnet: . ack 1 win 16695
19:46:42.555222  In IP 192.168.0.28.57575 > 1.1.1.1.telnet: P 1:7(6) ack 1 win 16695
19:46:42.628810 Out IP 1.1.1.1.telnet > 192.168.0.28.57575: P 1:16(15) ack 7 win 33387
```

Neat, we can do a quick packet capture from the CLI. The output above shows OSPF at 224.0.0.5 and a telnet session from 192.168.0.28 to 1.1.1.1.

Link Aggregation Groups (LAG)

Ok, for this lab we will need to cable things up quick. I have installed a cable between J2 and J3 on ports fe-0/0/6 and fe-0/0/7 as per the diagram below:



Once that is cabled, we can now configure our LAG connection between the two devices.

First up though, we need to delete the existing configuration on the old interfaces since we will be reusing IPs and such. Want to keep this simple.

J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# delete interfaces ge-0/0/1

[edit]
jfry@J2# commit and-quit
```

J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# delete interfaces fe-0/0/1

[edit]
jfry@J3# commit and-quit
```

Now we can configure our LAG on J2 first:

```
jfry@J2> edit
Entering configuration mode
```

First we need to tell it how many aggregate interfaces we want, for this example we will use 2:

```
[edit]
jfry@J2# set chassis aggregated-devices ethernet device-count 2
```

Now we need to tell the device what interfaces will be in 802.3ad and assigned them to aggregate Ethernet interface 0 (ae0)

```
[edit]
jfry@J2# set interfaces fe-0/0/6 fastether-options 802.3ad ae0

[edit]
jfry@J2# set interfaces fe-0/0/7 fastether-options 802.3ad ae0
```

Now we can configure the ae0 interface with an IP. This is just like any other interface we have configured.

```
[edit]
jfry@J2# set interfaces ae0 unit 0 family inet address 192.168.23.3/24
```

And then set LACP to ACTIVE mode under the aggregate interface:

```
[edit]
jfry@J2# set interfaces ae0 aggregated-ether-options lacp active

[edit]
jfry@J2# commit and-quit
commit complete
```

And now J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# set chassis aggregated-devices ethernet device-count 2

[edit]
jfry@J3# set interfaces fe-0/0/6 fastether-options 802.3ad ae0

[edit]
jfry@J3# set interfaces fe-0/0/7 fastether-options 802.3ad ae0

[edit]
jfry@J3# set interfaces ae0 unit 0 family inet address 192.168.23.3/24

[edit]
jfry@J3# set interfaces ae0 aggregated-ether-options lacp active

[edit]
jfry@J3# commit and-quit
commit complete
```

Now to see if our interface is up:

```
jfry@J2> show interfaces ae0 brief
Physical interface: ae0, Enabled, Physical link is Up
  Link-level type: Ethernet, MTU: 1514, Speed: 200mbps, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Disabled
  Device flags   : Present Running
  Interface flags: SNMP-Traps Internal: 0x0

  Logical interface ae0.0
    Flags: SNMP-Traps 0x0 Encapsulation: ENET2
    Security: Zone: Null
    inet  192.168.23.2/24

jfry@J2>
```

Good, its up and the speed is 200mbps, just as it should be.
Now we can look at LACP: *(sorry for the font change, had to move to a fixed-width)*

```
jfry@J2> show lacp interfaces
Aggregated interface: ae0
    LACP state:       Role   Exp   Def  Dist  Col  Syn  Aggr  Timeout  Activity
      fe-0/0/6       Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
      fe-0/0/6     Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
      fe-0/0/7       Actor    No    No   Yes  Yes  Yes   Yes     Fast    Active
      fe-0/0/7     Partner    No    No   Yes  Yes  Yes   Yes     Fast    Active
    LACP protocol:        Receive State  Transmit State          Mux State
      fe-0/0/6                  Current   Fast periodic Collecting distributing
      fe-0/0/7                  Current   Fast periodic Collecting distributing

jfry@J2>
```

Ok, lets test a PING quick and then we can reconfigure OSPF over this link.

```
jfry@J3> ping 192.168.23.2 rapid
PING 192.168.23.2 (192.168.23.2): 56 data bytes
!!!!!
--- 192.168.23.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 2.085/2.182/2.290/0.079 ms

jfry@J3>
```

Good, now to reconfigure OSPF:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# set protocols ospf area 0 interface ae0

[edit]
jfry@J2# commit and-quit
```

and now J3:

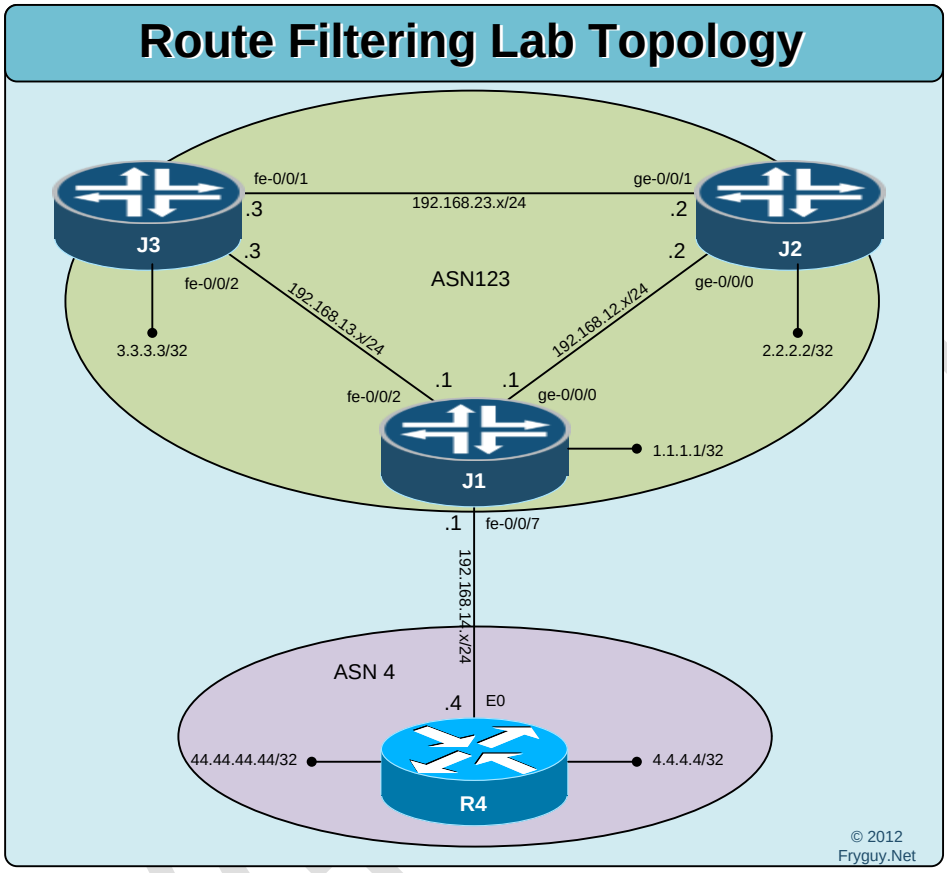
```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# set protocols ospf area 0 interface ae0

[edit]
jfry@J3# commit and-quit
commit complete
Exiting configuration mode
```

Now lets see if we have an OSPF neighbor on that interface:

```
jfry@J2> show ospf neighbor
Address         Interface              State     ID               Pri  Dead
192.168.23.3    ae0.0                  2Way      3.3.3.3          128    39
192.168.12.1    ge-0/0/0.0             Full      1.1.1.1          128    35

jfry@J2>
```

There you go, we have a neighbor on ae0.0 between the routers!

Route Filtering



Ok, lets discuss Route Filtering in this lab, and to keep is simple, we will use eBGP for the routing protocol. For this lab we will need to create another loopback on R4 for 44.44.44.44/32.

The goal of this lab is in 3 parts.

Part 1: Full reachability

Part 2: Filter 44.44.44.44/32 in on J1

Part 3: Filter 1.1.1.1/32, 2.2.2.2/32, and 3.3.3.3/32 to R4

The first step is yours as we need to reset all configs to the rollback/base configurations.

Ok, lets get started!

On R4 we will need to create Loopback1 and configure BGP to peer with J1:

```
R4# config t
R4(config)#int lo1
R4(config-if)#ip add 44.44.44.44 255.255.255.255
```

```
R4(config-if)# router bgp 4
R4(config-router)#no auto-summary
R4(config-router)#nei 192.168.14.1 remote-as 123
R4(config-router)#net 4.4.4.4 mask 255.255.255.255
R4(config-router)#net 44.44.44.44 mask 255.255.255.255
R4(config-router)#^Z
R4#
```

Ok, we will start with J2, then J3, and finally J1 for the configuration.

J2:

```
jfry@J2> edit
Entering configuration mode

[edit]
jfry@J2# set policy-options policy-statement Connected term 1 from protocol direct

[edit]
jfry@J2# set policy-options policy-statement Connected term 1 then accept

[edit]
jfry@J2# set routing-options autonomous-system 123

[edit]
jfry@J2# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J2# set type internal

[edit protocols bgp group ibgp]
jfry@J2# set neighbor 192.168.23.3

[edit protocols bgp group ibgp]
jfry@J2# set neighbor 192.168.12.1

[edit protocols bgp group ibgp]
jfry@J2# up

[edit protocols bgp]
jfry@J2# set export Connected


[edit protocols bgp]
jfry@J2# commit and-quit
commit complete
Exiting configuration mode
```

```
jfry@J2>
```

Ok, onto J3:

```
jfry@J3> edit
Entering configuration mode

[edit]
jfry@J3# set policy-options policy-statement Connected term 1 from protocol direct

[edit]
jfry@J3# set policy-options policy-statement Connected term 1 then accept

[edit]
jfry@J3# set routing-options autonomous-system 123

[edit]
jfry@J3# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J3# set type internal

[edit protocols bgp group ibgp]
jfry@J3# set neighbor 192.168.23.2

[edit protocols bgp group ibgp]
jfry@J3# set neighbor 192.168.13.1

[edit protocols bgp group ibgp]
jfry@J3# up

[edit protocols bgp]
jfry@J3# set export Connected

[edit protocols bgp]
jfry@J3# commit and-quit
```

Now for J1:

```
jfry@J1> edit
Entering configuration mode

[edit]
jfry@J1# set policy-options policy-statement Connected term 1 from protocol direct

[edit]
jfry@J1# set policy-options policy-statement Connected term 1 then accept

[edit]
jfry@J1# set routing-options autonomous-system 123

[edit]
jfry@J1# edit protocols bgp group ibgp

[edit protocols bgp group ibgp]
jfry@J1# set type internal

[edit protocols bgp group ibgp]
jfry@J1# set neighbor 192.168.12.2

[edit protocols bgp group ibgp]
jfry@J1# set neighbor 192.168.13.3

[edit protocols bgp group ibgp]
jfry@J1# up

[edit protocols bgp]
jfry@J1# set export Connected

[edit protocols bgp]
jfry@J1# edit group ebgp

[edit protocols bgp group ebgp]
jfry@J1# set type external

[edit protocols bgp group ebgp]
jfry@J1# set neighbor 192.168.14.4 peer-as 4

[edit protocols bgp group ebgp]
jfry@J1# up

[edit protocols bgp]
jfry@J1# commit and-quit
```

Ok, now that is complete we should have a full routing table on R4 and J3:
R4:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

B    192.168.12.0/24 [20/0] via 192.168.14.1, 00:02:12
     1.0.0.0/32 is subnetted, 1 subnets
B       1.1.1.1 [20/0] via 192.168.14.1, 00:02:12
B    192.168.13.0/24 [20/0] via 192.168.14.1, 00:02:12
     2.0.0.0/32 is subnetted, 1 subnets
B       2.2.2.2 [20/0] via 192.168.14.1, 00:02:12
C    192.168.14.0/24 is directly connected, Ethernet0
     3.0.0.0/32 is subnetted, 1 subnets
B       3.3.3.3 [20/0] via 192.168.14.1, 00:02:12
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
B    192.168.23.0/24 [20/0] via 192.168.14.1, 00:02:12
     44.0.0.0/32 is subnetted, 1 subnets
C       44.44.44.44 is directly connected, Loopback1
R4#
```

J3:

```
jfry@J3> show route

inet.0: 11 destinations, 14 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[BGP/170] 00:02:46, localpref 100
                     AS path: I
                   > to 192.168.13.1 via fe-0/0/2.0
2.2.2.2/32         *[BGP/170] 00:05:45, localpref 100
                     AS path: I
                   > to 192.168.23.2 via fe-0/0/1.0
3.3.3.3/32         *[Direct/0] 00:24:18
                   > via lo0.0
4.4.4.4/32         *[BGP/170] 00:02:42, MED 0, localpref 100
                     AS path: 4 I
                   > to 192.168.13.1 via fe-0/0/2.0
44.44.44.44/32     *[BGP/170] 00:02:42, MED 0, localpref 100
```

```
                AS path: 4 I
              > to 192.168.13.1 via fe-0/0/2.0
192.168.12.0/24    *[BGP/170] 00:02:46, localpref 100
                AS path: I
              > to 192.168.13.1 via fe-0/0/2.0
              [BGP/170] 00:05:45, localpref 100
                AS path: I
              > to 192.168.23.2 via fe-0/0/1.0
192.168.13.0/24    *[Direct/0] 00:24:18
              > via fe-0/0/2.0
              [BGP/170] 00:02:46, localpref 100
                AS path: I
              > to 192.168.13.1 via fe-0/0/2.0
192.168.13.3/32    *[Local/0] 00:24:18
                Local via fe-0/0/2.0
192.168.14.0/24    *[BGP/170] 00:02:46, localpref 100
                AS path: I
              > to 192.168.13.1 via fe-0/0/2.0
192.168.23.0/24    *[Direct/0] 00:06:20
              > via fe-0/0/1.0
              [BGP/170] 00:05:45, localpref 100
                AS path: I
              > to 192.168.23.2 via fe-0/0/1.0
192.168.23.3/32    *[Local/0] 00:06:20
                Local via fe-0/0/1.0

jfry@J3>
```

Good, now to test a PING from J3 to R4 Loopback1:

```
jfry@J3> ping 44.44.44.44 source 3.3.3.3 rapid
PING 44.44.44.44 (44.44.44.44): 56 data bytes
!!!!!
--- 44.44.44.44 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 3.201/3.352/3.735/0.194 ms

jfry@J3>
```

Good.

Now time to do some filtering. First up, we will filter R4 Loop1 (44.44.44.44/32) inbound on J1:

```
jfry@J1> edit
Entering configuration mode
```

First we will create a prefix-list matching 44.44.44.44/32:

```
[edit]
jfry@J1# set policy-options prefix-list R4ASN 44.44.44.44/32
```

Now we will create our policy statement to Reject the 44.44.44.44/32:

```
[edit]
jfry@J1# set policy-options policy-statement FromR4 term 1 from prefix-list R4ASN

[edit]
jfry@J1# set policy-options policy-statement FromR4 term 1 then reject
```

Then we will set our next statement to permit everything else:

```
[edit]
jfry@J1# set policy-options policy-statement FromR4 term 2 then accept
```

And finally we will edit our group/neighbor

```
[edit]
jfry@J1# edit protocols bgp group ebgp

[edit protocols bgp group ebgp]
jfry@J1# edit neighbor 192.168.14.4
```

And set our import rule:

```
[edit protocols bgp group ebgp neighbor 192.168.14.4]
jfry@J1# set import FromR4

[edit protocols bgp group ebgp neighbor 192.168.14.4]
jfry@J1# commit and-quit
```

Ok, now back to J3 to see what the routing table looks like:

```
jfry@J3> show route

inet.0: 10 destinations, 13 routes (10 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[BGP/170] 00:07:12, localpref 100
                     AS path: I
                   > to 192.168.13.1 via fe-0/0/2.0
2.2.2.2/32         *[BGP/170] 00:10:11, localpref 100
                     AS path: I
                   > to 192.168.23.2 via fe-0/0/1.0
3.3.3.3/32         *[Direct/0] 00:28:44
```

```
                > via lo0.0
4.4.4.4/32         *[BGP/170] 00:07:08, MED 0, localpref 100
                    AS path: 4 I
                  > to 192.168.13.1 via fe-0/0/2.0
192.168.12.0/24    *[BGP/170] 00:07:12, localpref 100
                    AS path: I
                  > to 192.168.13.1 via fe-0/0/2.0
                  [BGP/170] 00:10:11, localpref 100
                    AS path: I
                  > to 192.168.23.2 via fe-0/0/1.0
192.168.13.0/24    *[Direct/0] 00:28:44
                  > via fe-0/0/2.0
                  [BGP/170] 00:07:12, localpref 100
                    AS path: I
                  > to 192.168.13.1 via fe-0/0/2.0
192.168.13.3/32    *[Local/0] 00:28:44
                    Local via fe-0/0/2.0
192.168.14.0/24    *[BGP/170] 00:07:12, localpref 100
                    AS path: I
                  > to 192.168.13.1 via fe-0/0/2.0
192.168.23.0/24    *[Direct/0] 00:10:46
                  > via fe-0/0/1.0
                  [BGP/170] 00:10:11, localpref 100
                    AS path: I
                  > to 192.168.23.2 via fe-0/0/1.0
192.168.23.3/32    *[Local/0] 00:10:46
                    Local via fe-0/0/1.0

jfry@J3>
```

There you go, the 44.44.44.44/32 route is now filter from being accepted.

Now time to filter routes to R4:

```
jfry@J1> edit
Entering configuration mode

First up, create our prefix-lists to match J1, J2, and J3 loopbacks:
[edit]
jfry@J1# set policy-options prefix-list JLoopbacks 1.1.1.1/32

[edit]
jfry@J1# set policy-options prefix-list JLoopbacks 2.2.2.2/32

[edit]
jfry@J1# set policy-options prefix-list JLoopbacks 3.3.3.3/32
```

Now to create out policy statement to reject JLoopbacks and then permit everything else.

```
[edit]
jfry@J1# set policy-options policy-statement ToR4 term 1 from prefix-list JLoopbacks

[edit]
jfry@J1# set policy-options policy-statement ToR4 term 1 then reject

[edit]
jfry@J1# set policy-options policy-statement ToR4 term 2 then accept
```

Then, in one command, we will apply the export map:

```
[edit]
jfry@J1# set protocols bgp group ebgp neighbor 192.168.14.4 export ToR4

[edit]
jfry@J1# commit and-quit
```

Now back to look at R4 Routing table:

```
R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

B    192.168.12.0/24 [20/0] via 192.168.14.1, 00:07:04
B    192.168.13.0/24 [20/0] via 192.168.14.1, 00:07:04
C    192.168.14.0/24 is directly connected, Ethernet0
     4.0.0.0/32 is subnetted, 1 subnets
C       4.4.4.4 is directly connected, Loopback0
B    192.168.23.0/24 [20/0] via 192.168.14.1, 00:07:04
     44.0.0.0/32 is subnetted, 1 subnets
C       44.44.44.44 is directly connected, Loopback1
R4#
```

There you go, routes filter to R4!

Notes

Route Filtering

Ok, as you have seen there are different import and export policies for different protocols. Below is a chart that shows the Protocol – Default Import – Default Export policy for each:

Protocol	Default Import	Default Export
BGP	Accept all learned routes from configured neighbor	Export active BGP routes
IS-IS	Accept all IS-IS Routes	Reject Everything (uses flooding)
OSPF	Accept all OSPF routes	Reject Everything (uses flooding)
RIP	Accept all RIP routes from configured neighbors	Reject Everything. Must configure policy
EIGRP	Not supported ☺	Not supported ☺

Routing Protocol Administrative Distance Differences and Route Preferences

Junos has different Route Preference (Admin Distance) then Cisco IOS. A table that shows these differences is as follows:

Protocol	Cisco Admin Distance	Juniper Route Preference
Connected	0	0
Static	1	5
EIGRP	90 (Internal) 170 (External)	Not Applicable
OSPF	110	10 – Internal 150 – External
IS-IS	115	15 – Level 1 Internal 18 – Level 2 Internal 160 – Level 1 External 165 – Level 2 External
RIP	120	100
iBGP	200	170
eBGP	20	170

Juniper Routing Tables

Like Cisco IOS, Junos has different routing tables. Below is a list of what each one is and does:

Routing Table Name	Description
inet.0	IPv4 Unicast Routes
inet.1	Multicast Forwarding Cache
inet.2	Multicast BGP for RPF
inet.3	MPLS Path Information
inet.4	MSDP Routes
inet.6	IPV6 Unicast Routes
mpls.0	MPLS Next hops

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