KTH/CSC

Router Lab Reference

Juniper version

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1 Introduction

This document lists a number of specific routing protocol commands that can be useful in the routing labs. However, it is not at all a complete reference guide. For this, please consult the web at [2], where you can find all commands you want (and some more).

There is one section per topic which should list most of the commands that are required to complete the corresponding lab.

2 Reference: Host

The virtual hosts run SUSE linux and are accessed using ssh. The username on the host is laban. The name of the hosts are x1.xen.netlab.csc.kth.se, x1.xen.netlab.csc.kth.se, etc. The password will be provided to you at the time of the lab. To perform commands with super-user privileges, issue the sudo command. The hosts have two Ethernet interfaces: eth0 and eth1. One interface (eth1) has an allocated IP address via DHCP which enables Internet access. *Do not change the configuration of this interface*. The other interface (eth0) is used to connect to a router.

2.1 Configuring network access

```
ifconfig <interface> [up|down]
```
Activates/deactivates an interface, for example:
```
ifconfig eth1 up.
```

```
ip link set <interface> [up|down]
```
Alternative syntax.

```
ifconfig <interface> <address> netmask <netmask>
```
Assigns an IP number to an interface, e.g.
```
ifconfig eth1 193.11.23.12 netmask 255.255.255.0
```

```
ip addr add <address>/<len> dev <interface>
```
Alternative syntax.

```
route add -net <network> netmask <netmask> gw
<destination ip number>
```
Tells your workstation to route packets to a certain destination. To assign the default route to use next-hop 10.0.0.1:
```
route add -net 192.168.0.0 netmask 255.255.0.0 gw
10.0.0.1
```

```
ip route add <address>/<len> nexthop via <destination ip
number>
```
   Alternative syntax.

```
netstat -nr
```
   Shows the routing tables in the workstation.

```
sysctl -a
```
   Show all system configuration variable settings.

```
sysctl <variable>=<value>
```
   Assign a specific system configuration variable.

```
sysctl net.inet6.ip6.accept_rtadv=1
```
   Enable IPv6 router advertisements.

2.2 Connecting to your router

The central equipment in the router lab are 20 Juniper J4300 software routers. The routers are accessed remotely and do not need to be accessed physically. They are essentially PC:s equipped with six Ethernet interface cards with limited forwarding capacity in terms of performance, but without limitations in terms of functionality. The operating system is JunOS, a variant of the UNIX BSD operating system. The routers can be configured via html, or via XML. But in the labs, the Command Line Interface (CLI) will only be used to configure the routers.

To connect to the routers, you use telnet to a console server. In this way, you access the routers serial port. The following table shows which address and telnet port to use to connect:

Routers	Terminal server	Telnet port	User
RTA1-RTA4	terminal1.netlab.csc.kth.se	2001-2004	netusr
RTB1-RTB4	terminal1.netlab.csc.kth.se	2005-2008	netusr
RTC1-RTC4	terminal2.netlab.csc.kth.se	2001-2004	netusr
RTD1-RTD4	terminal2.netlab.csc.kth.se	2005-2008	netusr
RTE1-RTE4	terminal2.netlab.csc.kth.se	2009-2012	netusr

3   Reference: Basic commands
This section describes some general commands.

3.1 Operation commands
```
configure
edit
```

Go to configure mode

`show chassis`

Show information about the router chassis: hardware, alarms, etc.

`show interfaces [terse|bried|detail|extensive]`

Show information about the interfaces on the router.

`show route`

Show IP route information. Usually extended with the command `protocol` followed by protocol name.

`show system`

Underlying operating system status.

`monitor`

Start a monitoring of the system for debugging purposes.

`show log`

Display log files

`set cli`

Set CLI properties

`restart`

Restart a process/ software module

`request system reboot`

Reboots the system

`request system halt`

Halts the system

`ping`

Ping another host

`ping [record-route | source]`

Ping another host using record-route| specify a source address.

`traceroute`

Traceroute to another host

3.2 Configure commands

`set`

Set a configuration parameter

`delete`

Delete a configuration parameter

`edit`

Edit a sub-element

`top`

Go to top of configure mode

`exit`

Leave configure mode and go to operations mode

`load override <filename>`

Load a configuration from file. Replace the old configuration with the one on the file.

`load merge <filename>`

Load a configuration from file. Merge the file with the current configuration.

`load merge terminal [relative]`

Load a configuration from the terminal. In this way, you can

cut and paste configurations without using the `set` command.

`rollback [<number>]`

> Rollback configuration to last step (or specified number of steps).

`set file <filename> interactive-commands any`

> Log all CLI commands on file.
>
> steps).

`save <filename>`

> Save a configuration to file

`commit [check]`

> Activate the configuration. If the check option is used, all run-time sanity checks will be made, but the configuration will not actually be committed.

`show`

> Show the current configuration. May be non-committed. Keywords can be any part of the configuration, such as `system`, `protocols`, etc.

`show | compare`

> Show the difference between the current configuration being edited and the committed state of the router.

`show | display set`

> Show the configuration using `set` commands. Useful if you want to cut and paste commands.

4   Reference: Static routing

This section describes the commands used in the introductory static routing lab.

4.1 Operation commands

`show route`

> Show all routes

`show route protocol static`

> Show all static routes

4.2 Configure commands

`set interfaces <ifname> unit 0 family inet address <prefix>`

> Set an interface address

`set routing-options static route <prefix> next-hop <ip-address>`

> Create a static route

`set routing-options static route <prefix> qualified-next-hop <ip-address> metric <nr>`

> Create a static route with a specific metric.

`set interface <ifname> disable`

> Disable an interface.

`delete interface <ifname> disable`

> Enable an interface again.

5 Reference: Firewalls

This section describes the syntax of firewalls: packet filters and policers. Note that only a small set of the filter and policer syntax is listed here.

5.1 Operation commands

`show firewall [log|counter|filter]`
> Show information about firewalls.

`show interfaces filters`
> Show information about interface filters.

`show policers`
> Show all policers status

`show interfaces policers`
> Show interface policers

5.2 Configure commands

`set interfaces <ifname> unit <nr> family inet filter input <name>`
> Associate incoming traffic on interface with filter

`set interfaces <ifname> unit <nr> family inet filter output <name>`
> Associate outgoing traffic on interface with filter

`set interfaces <ifname> unit <nr> family inet policer input <name>`
> Associate incoming traffic on interface with policer

`set interfaces <ifname> unit <nr> family inet policer output <name>`
> Associate outgoing traffic on interface with policer

`set firewall filter <name> term <name> from destination-address <prefix>`
> Create filter match condition for IP destination addresses

`set firewall filter <name> term <name> from source-address <prefix>`
> Create filter match condition for IP source addresses

`set firewall filter <name> term <name> from destination-port <range>`
> Create filter match condition for TCP/UDP destination ports.

`set firewall filter <name> term <name> from source-port <range>`
> Create filter match condition for TCP/UDP source ports.

`set firewall filter <name> term <name> from dscp <range>`
> Create filter match condition for Diffserv code points.

`set firewall filter <name> term <name> from icmp-code <range>`
> Create filter match condition for ICMP packet types.

`set firewall filter <name> term <name> from tcp-established`

Create filter match condition for established TCP connections.

```
set firewall filter <name> term <name> then discard
```
Create filter action: silent discard.
```
set firewall filter <name> term <name> then reject
[<how>]
```
Create filter action: drop and send ICMP back to sender.
```
set firewall filter <name> term <name> then accept
```
Create filter action: accept the packet.
```
set firewall filter <name> term <name> then policer
<name>
```
Create filter action: activate a policer.
```
set firewall filter <name> term <name> then log
```
Create filter action: log the packet.
```
set firewall policer <name> if-exceeding bandwidth-limit
<limit>
```
Set average bandwidth limit on a policer in absolute bps.
```
set firewall policer <name> if-exceeding burst-size-limit
<limit>
```
Set burst size on a policer in bytes.
```
set firewall policer <name> then discard
```
Drop all packets exceeding the policers threshold.
```
set firewall policer <name> then loss-priority
```
Change loss-priority (Diffserv) of packets exceeding the policers threshold.

6 Reference: RIP

This section describes the RIP related router commands in JunOS.

6.1 Operation commands
```
show rip neighbor
```
Show the RIP neighbors
```
show rip statistics
```
Show statistics about RIP
```
show route protocol rip
```
Show RIP routes
```
show route advertising-protocol rip <your-ip-address>
```
Show which routes RIP adverises to its neighbours.
```
restart routing gracefully
```
Restart the routing process.

6.2 Configure commands
```
set protocols rip group <name> neighbor <interface>
```
Configure RIP on interface where there is a neighbouring router.
```
set protocols rip traceoptions file <name> size <size>
```
Create a log file for tracing of RIP events
```
set protocols rip traceoptions flag update detail
```
Turn on detailed tracing of RIP. Use the monitor command to

see the tracing.

`set protocols rip group <name> export <name>`
> Invoke a policy-option for RIP

`set routing-options static route <prefix> discard`
> Create a (null) static route

`set routing-options aggregate route <prefix> discard`
> Create a local aggregated route

`set routing-options aggregate route <prefix> policy <name>`
> Create an aggregated route with an associated policy (which must be acccepted in order for the route to be created.

`set routing-options router-id <address>`
> Set id of this router. Recommended to be a routable address.

`set routing-options forwarding-table export <name>`
> Apply a policy on FIB (can be used for load-balancing)

`set policy-options policy-statement <name> then load-balance per-packet`
> Set a policy for load-balancing to install all next-hops with equal cost. Need also to apply this to RIB->FIB translation

`set forwarding-options hash-key family inet layer-3`
> Force load-balancing (if enabled) to use only IP addresses

`set forwarding-options hash-key family inet layer-4`
> Force load-balancing (if enabled) to use also layer -4 info, including ports and incoming interfaces. You must also specify layer-3 for this to take effect.

7 OSPF Commands

7.1 Operation commands

`show ospf database`
> Show the link-state database. Useful extensions are `router`, `network` and `extern`, for example. In the output, (*) indicates that the LSA is generated by your router. Also, you can append the usual externsions: detail or extensive if you want to have more information.

`show ospf database advertising-router <id>`
> Show which LSA:s are announced by a specific router.

`show ospf database | match router | count`
> Count the number of routers

`show ospf neighbor`
> Show which routes OSPF advertises to its neighbours

`show ospf interface`
> Show which routes OSPF advertises to its neighbours

`show ospf statistics`
> Show counters and other statistics related to OSPF

`show ospf route`

> Show OSPF routes (with OSPF info)

`show route protocol ospf`
> Show OSPF routes in the routing table

`restart routing gracefully`
> Restart the routing (in a nice way)

`clear ospf neighbour`
> Clear the OSPF neighbour adjacencies

`clear ospf database purge`
> Clear the OSPF database (locally)

7.2 Configure commands

`set routing-options router-id <address>`
> Set id of this router. Should be a routable address.

`set protocols ospf area <nr> interface <interface>`
> Turn on OSPF on an interface.

`set protocols ospf area <nr> interface <interface> interface-type <type>`
> Change interface behaviour, (nbma, p2mp, p2p).

`set protocols ospf area <nr> interface <interface> passive`
> Do not run OSPF on an interface, but announce its network.

`set protocols ospf area <nr> stub`
> Set an OSPF stub area.

`set protocols ospf area <nr> stub default-metric <nr>`
> Inject default route into stub area.

`set protocols ospf area <nr> stub no-summaries`
> Stop LSA-3 into area. (totally stub)

`set protocols ospf area <nr> nssa`
> Set an OSPF not-so-stubby area.

`set protocols ospf traceoptions file <name>`
> Create a log file for tracing of OSPF events

`set protocols ospf traceoptions flag hello detail`
> Turn on detailed tracing of OSPF. Other traceoptions include `error` and `lsa-update`.

`set policy_options policy_statement <name> then metric <nr>`
> Set metric in a policy. Useful when exporting external routes, for example.

8 ISIS Commands

8.1 Operation commands

`show isis database`
> Show the link-state database.

`show isis adjacency`
> Show ISIS neighbours

`show isis statistics`

Show counters and other statistics related to ISIS

`show isis spf log`

Examine shortest path first calculation log.

`show isis spf result`

Show the results of the SPF calculations.

`show route protocol isis`

Show ISIS routes in the routing table

8.2 Configure commands

`set protocols isis interface <name>`

Turn on ISIS on an interface.

`set protocols isis interface <name> passive`

Include the interface in IS-IS link-state, but do not send IS-IS protocol on the interface.

`set protocols isis interface <name> level 1 disable`

Disable level 1 areas on one interface – only do level 2.

`set protocols isis interface <if> point-to-point`

Change inteface behaviour to p2p.

`set protocols isis level 1 disable`

Disable level 1 areas on all interfaces.

`set interfaces <name> unit 0 family iso`

Enable OSI on an interface.

`set interfaces lo0 unit 0 family iso address <iso-addr>`

Set iso address.

`set interfaces lo0 unit 0 family inet6 address <ipv6addr>`

Set IPv6 address.

`set protocols router-advertisement interface <name> prefix <ipv6addr>`

Enable IPv6 router advertisements on interface for specific prefix.

9 BGP Commands

9.1 Operation commands

`show bgp summary`

List all BGP peers with summary information.

`show route <prefix> detail`

Display detailed information for a given prefix.

`show route receive-protocol bgp <address>`

Display routes received by a peer before policy is applied.

`show route advertising-protocol bgp <address>`

Display routes advertised to a specific peer.

`show route receive-protocol bgp <address>`

Display routes received by a peer before policy is applied.

`clear bgp neighbor <ip> [soft]`

Display routes received by a peer before policy is applied.

`monitor [start|stop] <file>`

Start/Stop monitor output from file to terminal.

9.2 Configure commands

```
set routing-options router-id <ip>
```
     Set router id.
```
set routing-options autonomous-system <ASN>
```
     Set AS Number.
```
set protocols bgp local-as <ASN>
```
     Set AS Number.
```
set protocols bgp export <policy>
```
     Set export rules.
```
set protocols bgp group <group> peer-as <ASN>
```
     Set peer AS Number.
```
set protocols bgp group <group> type [internal|external]
```
     Set external/internal type.
```
set protocols bgp group <group> neighbor <peer-ip>
```
     Set peer ip.
```
set protocols bgp group <group> cluster <cluster-id>
```
     Configure route reflection.
```
set protocols bgp traceoptions file <file>
```
     File for bgp monitoring.
```
set protocols bgp traceoptions flag [update|open|all|...]
[detail]
```
     Set traceoptions flags for monitoring bgp details.
```
set protocols bgp advertise-inactive
```
     Make BGP advertise routes even if they are not active in the local routing table (because IGP is preferred).

9.3 Policy options

```
edit policy-options
```
     All following commands in this edit mode.
```
set prefix-list <name> <prefix>/<length>
```
     Create a prefix list.
```
set policy-statement <name> from prefix-list <name>
```
     Create an policy statement using a prefix list.
```
set as-path <name> <reg-exp>
```
     Create an AS-path reg-exp list.
```
set policy-statement <name> from as-path <name>
```
     Create an policy statement using an AS-path list.

10 PIM/MSDP/IGMP Commands

10.1 Operation commands

```
show igmp group
```
     Show IGMP group state
```
show igmp interface
```
     Show IGMP interface state.
```
show igmp statistics
```
     Show IGMP statistics
```
show pim bootstrap
```

Show RP Bootstrap Router information.
```
show pim interface
```
Show the multicast status on an interface.
```
show pim join [extensive]
```
Show PIM join/prune state.
```
show pim rps [extensive]
```
Show rendezvous points.
```
show pim statistics
```
Show counters and other statistics related to PIM
```
show pim source
```
Show source information
```
show multicast route
```
Show multicast route information.
```
show msdp
```
Show standard MSDP information for all routers.
```
show msdp source-active
```
Show the MSDP source-active cache.
```
show route table inet.2
```
Show PIM-SM table.
```
show route table inet.4
```
Show MSDP table.

10.2 Configure commands
```
set protocols pim interface <name> mode sparse
```
Turn on PIM-SM on an interface.
```
set protocols pim rp static addr <addr>
```
Manually assign a remote rendezvous point.
```
set protocols pim rp local family inet address <addr>
```
Assign the local rendezvous point address.
```
set protocols msdp local-address <addr>
```
Set local MSDP address.
```
set protocols msdp group <name> mode mesh-group
```
Declare that MSDP works in full mesh mode.
```
set protocols msdp [group <name>] peer <addr>
```
Define one MSDP peer
```
set protocols msdp group name export <name>
```
Set an MSDP export policy (which senders to announce).

11 MPLS Commands

11.1 Operation commands
```
clear mpls lsp <name>
```
Clear dynamic LSP ingress sessions (only locally)
```
show mpls interface
```
Show MPLS status of interfaces
```
show mpls lsp [extensive]
```
Show information about label-switched path.
```
show route table inet.3
```
Show table containing LSP egress points for use by BGP only.

```
show route table mpls.0
```
Show MPLS label swapping table.

11.2 Configure commands

```
set interfaces <name> unit <nr> family mpls
```
Enable MPLS on an interface.
```
set protocols mpls no-cspf
```
Disable constrained-path LSPs.
```
set protocols mpls explicit-null
```
Enable the egress router to pop label if it is zero.
```
set protocols mpls icmp-tunneling
```
Enable ICMP replies to be tunnelled back to original source.
```
set protocols mpls interface [<name> | all]
```
Turn on MPLS on one (or all) interfaces.
```
set protocols mpls interface <name> label-map <nr> next-
hop <ipaddr>
```
Specify a next-hop for a static LSP.
```
set protocols mpls label-switched-path <name> install
<addr>
```
Install the destination prefixes for the lsp in the inet.3 table
```
set protocols mpls label-switched-path <name> install
<addr> active
```
Install the destination prefixes for the lsp in the inet.1 table
```
set protocols mpls interface <name> label-map <nr> swap
<label>
```
Specify a swap label operation for a static LSP.
```
set protocols mpls interface <name> label-map <nr> swap-
push <swap-label> <push-label>
```
Specify a combined swap-push label operation of a static LSP.
```
set protocols mpls label-switched-path <name> to <addr>
```
Set up a dynamic LSP to egress router.
```
set protocols mpls label-switched-path <name> no-cspf
```
Turn off constrained path LSP computation.
```
set protocols mpls label-switched-path <name> bandwidth
<bw>
```
Reserv bandwidth (using RSVP) along an LSP.
```
set protocols mpls label-switched-path <name> primary
<path>
```
Set up a dynamic LSP using a primary path.
```
set protocols mpls label-switched-path <name> secondary
<path>
```
Set up a dynamic LSP specifying a secondary path.
```
set protocols mpls static-path inet <prefix> next-hop
<addr>
```
Specify the next-hop of an ingress static LSP to <prefix>.
```
set protocols mpls static-path inet <prefix> push <label>
```
Specify a push label of an ingress static LSP.
```
set protocols mpls static-path inet <prefix> double-push
<bottom-label> <top-label>
```

Specify a double push label-operation of an ingress static LSP.

```
set protocols mpls static-path inet <prefix> pop
```
Specify a pop of a static LSP.

```
set protocols mpls path <path> <addr> [strict | loose]
```
Create a named path using strict or loose source routing.

```
set protocols mpls traffic-engineering bgp-igp
```
Install the dynamical ingress LSP routes into the inet.0 table.

12 RSVP Commands

12.1 Operation commands

```
clear rsvp session <name>
```
Clear a specific LSP session.

```
show rsvp interface
```
Show RSVP interface state.

```
show rsvp neighbor
```
Show RSVP neighbors.

```
show rsvp session [detail]
```
Show (detailed) information about RSVP/LSP state.

12.2 Configure commands

```
set protocols rsvp interface [<name> | all]
```
Turn on RSVP on one (or all) interfaces.

```
set protocols rsvp traceoptions flag [packets|error]
```
Turn on RSVP traceoptions.

13 References

[1]   KTH/CSC Router lab Introduction - Juniper version
[2]   JunOS reference manual
http://www.juniper.net/techpubs/software/junos/junos90/index.html