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S-38.2131/3133 Networking Technology, laboratory course A/B

Juniper J2330 IPv4 HowTo

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1 The Hardware & Junos

1.1 Environment

The routers have at least four Gigabit Ethernet interfaces named *ge-0/0/0*, *ge-0/0/1*, *ge-0/0/2* and *ge-0/0/3*. Routers can also have up to three additional PIMs (Physical Interface Module), which add more interfaces. All interfaces can be assigned one or more IP addresses. The addresses show up as logical interfaces. The logical interfaces are named *ge-0/0/0.0*, *ge-0/0/0.1* and so on. Routers also have a serial port for configuration, but hopefully it's not needed during the assignments.

All routing management during the exercise is done using the Junos Command Line Interface (CLI), which is a simple text based hierarchical command interface. CLI session is initiated by giving the command `cli`, while logged into a router using SSH. CLI is started automatically, when using the **student** user account. After launch CLI is in *operational mode*, which is mainly used to monitor system status. *Configuration mode* is enabled by issuing the command `configure` in *operational mode*. In this mode users can make changes to the router settings. In *configuration mode* there is a banner indicating in which hierarchy level the user is currently located. Users are actually configuring a copy of the running configuration and the changes don't take effect until `commit` command is given [1]. Routers have also a graphical web interface called J-Web, but it's not used during the assignments. Web interface is useful when you want to monitoring system status, but configuring settings is faster using CLI [2].

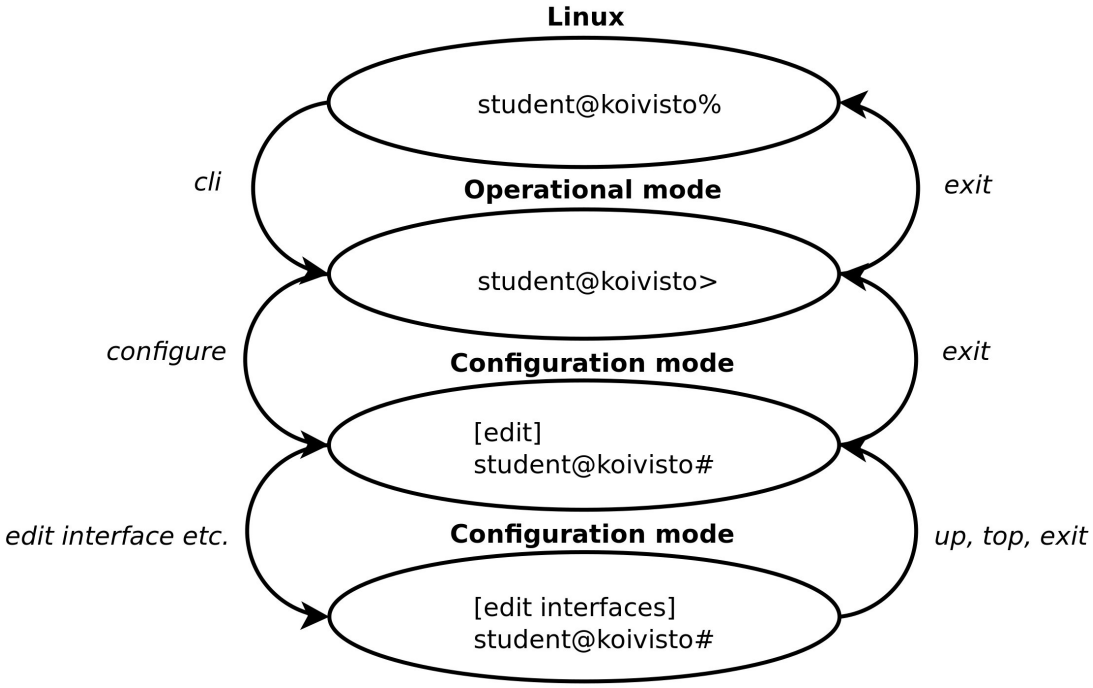

Figure 1: CLI command hierarchy

1.2 Basic Commands

The most basic commands used in CLI are the following:

- `set`: Adds a new configuration or overwrites an old one.

```
# set interfaces ge-1/0/1 unit 0 family inet address
  10.255.161.1/30
```

- `edit`: Move down through an existing configuration command hierarchy, or create a hierarchy and move down to that level.

```
# edit interfaces ge-1/0/1
```

- `commit`: Saves and activates the changes to the running configuration.
- `delete`: Removes settings in *configuration mode*.

```
# delete interfaces ge-1/0/1
```

- `up`: Moves up one hierarchy level.
- `top`: Moves to the top of edit hierarchy.
- `show`: Settings can be seen using the `show` command. Alternatively, in *configuration mode*, you can use `show | display set`, which shows the configuration in the form of `set` commands. The `show` command can also be used outside the *configuration mode* to show useful information about the router's current state, such as routing statistics.
- `exit`: Moves to the top of edit hierarchy, exits *configuration mode*, exits *operational mode* etc.
- `?`: The easiest way to get help is to type `?`. It works even in the middle of a command.

```
student@ahtisaari\# set protocols ospf area ?
Possible completions:
  <area_id>               Area ID
  0.0.0.0                 Area ID
```

- `rollback`: Routers store automatically 50 (0...49) last used configurations, where number 0 is the current running configuration. By using `rollback` command, these configurations can be loaded again. Configurations can also be saved and loaded with the `save` and `load` commands. Saved configurations are stored in the user's home folder.

CLI supports command autocompletion in all modes using the space bar or the tabulator key. *Operational mode* commands (e.g. `ping` or `traceroute`) can also be used in *configuration mode* by giving the command `run` before the actual command.

```
[edit]
# run ping <ADDRESS>
```

2 IP address and Interface Configuration

The physical interfaces are named using the format *type-pim/0/port*. In the lab setup the type is always *ge* (Gigabit Ethernet) and the *pim* is usually 0, as there are only two routers with additional PIMs installed. In order to enable a Gigabit Ethernet interface and assign an IPv4 address to it, you need to issue the command:

```
# set interfaces <INTERFACE> unit <N> family inet address
  <ADDRESS/PREFIX>
```

Loopback interfaces are also configured in the same manner and they are named *lo0*. Interfaces also have many additional parameters, not used in this lab work, such as vlan-tagging, speed and encapsulation. [3]

3 DHCP and Static routes

For setting up a DHCP server at least an interface address, address pool, address range and a router address have to be assigned. It is also useful to advertise a name server and a domain name. DHCP can be enabled in the J2330 router with the following commands:

```
# set interfaces <INTERFACE> unit <N> family inet address
  <ADDRESS/PREFIX>
# set system services dhcp pool <ADDRESS/PREFIX>
# set system services dhcp pool <ADDRESS/PREFIX> address-range low
  <ADDRESS>
# set system services dhcp pool <ADDRESS/PREFIX> address-range high
  <ADDRESS>
# set system services dhcp pool <ADDRESS/PREFIX> router <ADDRESS>
# set system services dhcp pool <ADDRESS/PREFIX> domain-name
  <DOMAIN>
# set system services dhcp pool <ADDRESS/PREFIX> name-server
  <ADDRESS>
```

In addition to the routing protocols' dynamic routes, it's also possible to add static routes manually. The default gateway can be configured using address 0.0.0.0/0.

```
# set routing-options static route  <ADDRESS/PREFIX> next-hop
  <ADDRESS>
```

4 RIPv2

4.1 Available Settings

Possible settings in `protocols rip`:

- `apply-groups`: Groups from which to inherit configuration data
- `apply-groups-except`: Don't inherit configuration data from these groups
- `authentication-key`: Authentication key (password)
- `authentication-type`: Authentication type
- `check-zero`: Check reserved fields on incoming RIPv2 packets
- `graceful-restart`: RIP graceful restart options
- `group`: Instance configuration
- `holddown`: Hold-down time (10..180 seconds)
- `import`: Import policy
- `message-size`: Number of route entries per update message (25..255)
- `metric-in`: Metric value to add to incoming routes (1..15)
- `no-check-zero`: Don't check reserved fields on incoming RIPv2 packets
- `receive`: Configure RIP receive options
- `rib-group`: Routing table group for importing RIP routes
- `route-timeout`: Delay before routes time out (30..360 seconds)
- `send`: Configure RIP send options
- `traceoptions`: Trace options for RIP
- `update-interval`: Interval between regular route updates (10..60 seconds)

Possible settings in `protocols rip group <NAME>`:

- `apply-groups`: Groups from which to inherit configuration data
- `apply-groups-except`: Don't inherit configuration data from these groups
- `bfd-liveness-detection`: Bidirectional Forwarding Detection options
- `export`: Export policy
- `import`: Import policy
- `metric-out`: Default metric of exported routes (1..15)

- `neighbor`: Neighbor configuration
- `preference`: Preference of routes learned by this group
- `route-timeout`: Delay before routes time out (30..360 seconds)
- `update-interval`: Interval between regular route updates (10..60 seconds)
- `|`: Pipe through a command

4.2 Basic Configuration

To enable RIP routing a rip group has to be created, and all the router interfaces using RIP have to be added as neighbors to that same group. [4]

```
# set protocols rip group <GROUP_NAME> neighbor <INTERFACE>
```

The default metric added to the routes imported from a specific neighbor can be changed. The default value is 1 and the maximum is 16.

```
# set protocols rip group <GROUP_NAME> neighbor <INTERFACE>
  metric-in <N>
```

By default, the routers do not advertise routing information to their neighbors. To enable route advertising, export policies must be created [5].

Advertise routes learned from direct neighbors

```
# set policy-options policy-statement <POLICY_NAME> from protocol
  direct
# set policy-options policy-statement <POLICY_NAME> then accept
# set protocols rip group <GROUP_NAME> export <POLICY_NAME>
```

Advertise routes learned from RIP protocol

```
# set policy-options policy-statement <POLICY_NAME> from protocol
  rip
# set policy-options policy-statement <POLICY_NAME> then accept
# set protocols rip group <GROUP_NAME> export <POLICY_NAME>
```

RIP routing can be disabled simply by giving the command:

```
# delete protocols rip
```

5 OSPFv2

5.1 Available Settings

Possible settings in `protocols ospf`:

- `apply-groups`: Groups from which to inherit configuration data
- `apply-groups-except`: Don't inherit configuration data from these groups
- `area`: Configure an OSPF area
- `disable`: Disable OSPF
- `export`: Export policy
- `external-preference`: Preference of external routes
- `graceful-restart`: Configure graceful restart attributes
- `import`: Import policy (for external routes or setting priority)
- `no-nssa-abr`: Disable full NSSA functionality at ABR
- `no-rfc-1583`: Disable RFC1583 compatibility
- `overload`: Set the overload mode (repel transit traffic)
- `preference`: Preference of internal routes
- `prefix-export-limit`: Maximum number of prefixes that can be exported
- `reference-bandwidth`: Bandwidth for calculating metric defaults
- `rib-group`: Routing table group for importing OSPF routes
- `spf-options`: Configure options for SPF
- `traceoptions`: Trace options for OSPF
- `traffic-engineering`: Configure traffic engineering attributes

Possible settings in `protocols OSPF group <NAME>`:

- `apply-groups`: Groups from which to inherit configuration data
- `apply-groups-except`: Don't inherit configuration data from these groups
- `area-range`: Configure area ranges
- `interface`: Include an interface in this area
- `label-switched-path`: Configuration for advertisement of a label-switched path
- `network-summary-export`: Export policy for Type 3 Summary LSAs
- `network-summary-import`: Import policy for Type 3 Summary LSAs
- `peer-interface`: Configuration for peer interface
- `virtual-link`: Configure virtual links

5.2 Basic Configuration

To enable OSPF routing, an ospf area has to be created. All the interfaces using OSPF have to be individually added to an ospf area. The default metric for a Gigabit Ethernet interface is 1, but it can also be configured manually. [4]

```
# set protocols ospf area <AREA> interface <INTERFACE>
# set protocols ospf area <AREA> interface <INTERFACE> metric <N>
```

If not otherwise specified, the address of the loopback interface 0 (*lo0*) will be used as the Router ID. Router ID can also be manually selected with command:

```
# set routing-options router-id <ROUTER-ID>
```

Virtual links between OSPF routers can be created with the following command:

```
# set protocols ospf area <AREA> virtual-link neighbor-id
  <ROUTER-ID> transit-area <TRANSIT-AREA>
```

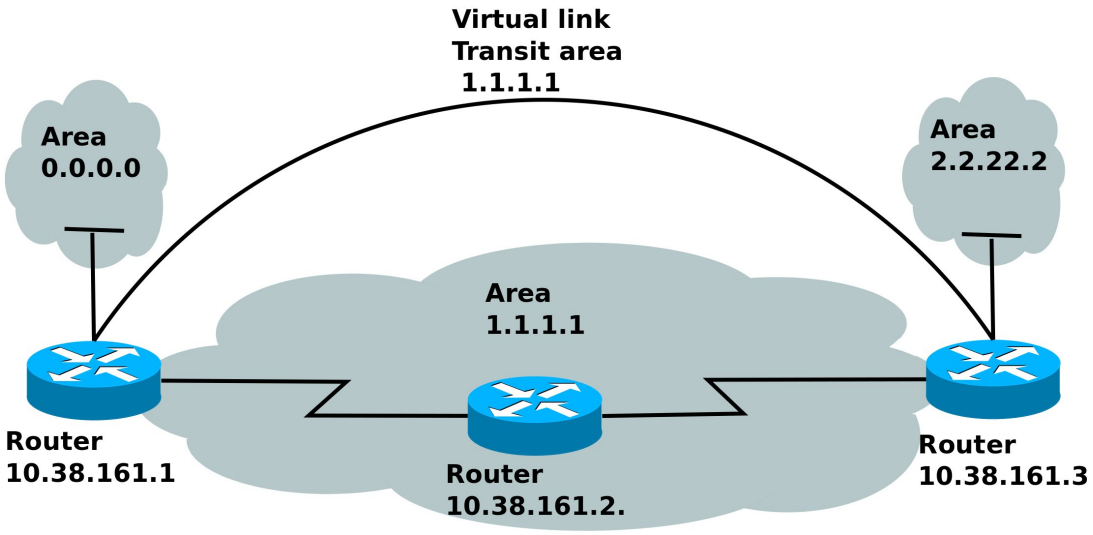

Figure 2: Virtual link

OSPFv2 protocol routers can be authenticated to guarantee that only trusted routers participate in the routing. Authentication settings have to be applied in the both ends of the link. A simple MD5 authentication can be implemented with the following command:

```
# set protocols ospf area <AREA> interface <INTERFACE>
  authentication md5 <N> key <STRING>
```

6 Redistributing Routing Information

Be default Juniper routers don't redistribute static routes or routes learned from other routing protocols. These routes can be exported by using the following kind of policies.

Static default route can be redistributed with the following policy:

```
# set policy-options policy-statement <POLICY_NAME> from
  route-filter 0.0.0.0/0 exact
# set policy-options policy-statement <POLICY_NAME> then accept
```

All static routes, such as directly connected links, can be distributed with the following policy:

```
# set policy-options policy-statement default-route from protocol
  direct
# set policy-options policy-statement default-route then accept
```

Policies have to be applied to the used routing protocols.

```
# set protocols ospf export <POLICY_NAME>
# set protocols rip group <GROUP_NAME> export <POLICY_NAME>
```

7 Security and load balancing

Juniper J-Series routers also provide firewall functions, which can be found in the security hierarchy level. To make the assignment simpler, the firewall has been preconfigured to allow all traffic by default.

The preconfigured security settings should look similar to the following:

```
# set security zones security-zone man host-inbound-traffic
  system-services all
# set security zones security-zone man host-inbound-traffic
  protocols all
# set security zones security-zone man interfaces all
# set security policies default-policy permit-all
```

When there are multiple equal-cost paths to the same destination, by default, the JUNOS Software randomly selects one of the next-hop addresses into the forwarding table. Whenever the set of next hops for a destination changes in any way, the next-hop address is chosen again, also in a random fashion.

You can configure the JUNOS Software so that, for the active route, all next-hop addresses for a destination are installed in the forwarding table. This is called per-packet load balancing.

```
# set policy-options policy-statement <POLICY_NAME> then
  load-balance per-packet
# set routing-options forwarding-table export <POLICY_NAME>
```

Terminology

- INTERFACE: One of the router's network interfaces, e.g., ge-0/0/0
- ADDRESS: An IPv4 address in dotted decimal format, e.g., 123.123.123.123
- PREFIX: The routing prefix in CIDR notation (0–32), i.e., how many bits of the address are used to indicate the network mask.
- NET_ADDRESS: The address of an IPv4 network, i.e., the first address of a network.
- AREA: An OSPF Area ID, e.g., 2.2.2.2.
- N: An integer
- STRING: A string of characters (no whitespace)

References

[1] Juniper. CLI User Guide. http://www.juniper.net/techpubs/en_US/junos9.6/information-products/topic-collections/swconfig-cli/swconfig-cli.pdf. Checked October 17, 2010.

[2] Juniper. J-Web Interface User Guide. http://www.juniper.net/techpubs/en_US/junos9.6/information-products/topic-collections/jweb-user-guide/jweb-user-guide.pdf. Checked October 17, 2010.

[3] Juniper. Network Interfaces Configuration Guide. http://www.juniper.net/techpubs/en_US/junos9.6/information-products/topic-collections/config-guide-network-interfaces/config-guide-network-interfaces.pdf. Checked October 17, 2010.

[4] Juniper. Routing Protocols Configuration Guide. http://www.juniper.net/techpubs/en_US/junos9.6/information-products/topic-collections/config-guide-routing/config-guide-routing.pdf. Checked October 17, 2010.

[5] Juniper. Routing Protocols and Policies Command Reference. http://www.juniper.net/techpubs/en_US/junos9.6/information-products/topic-collections/swcmdref-protocols/swcmdref-protocols.pdf. Checked October 17, 2010.