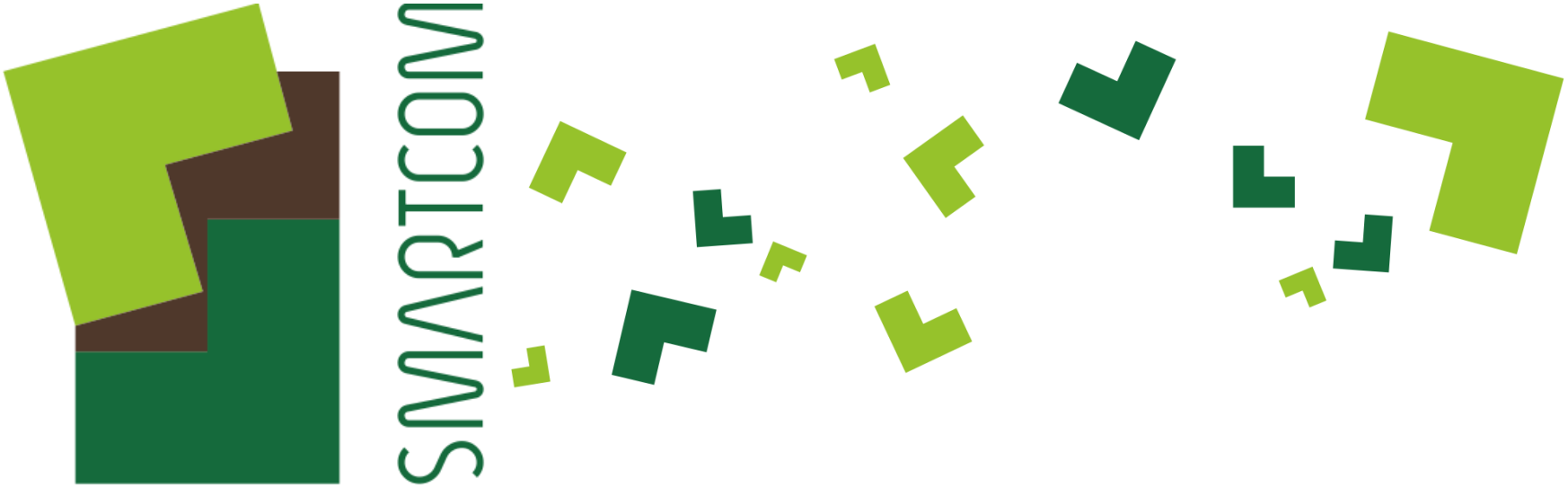



# JUNOS as a second language

Radostina Gercheva, JNCIP-ENT
*Smartcom Bulgaria AD*
Mircho Mirchev, JNCIP-SP/SEC/ENT
*Smartcom Bulgaria AD*

# QUIZ at 20:15

1st Award – TP-Link Wireless N Nano router (TL-WR802N)

2nd Award – Lenovo Mobile Power (MP506)

3rd Award – AData 32GB USB Flash drive

Questions - at 20:15

# Demo LAB

**Wi-Fi: SSID: MTF3201**
**Pass: mtf_3201**

**use an SSH client:**

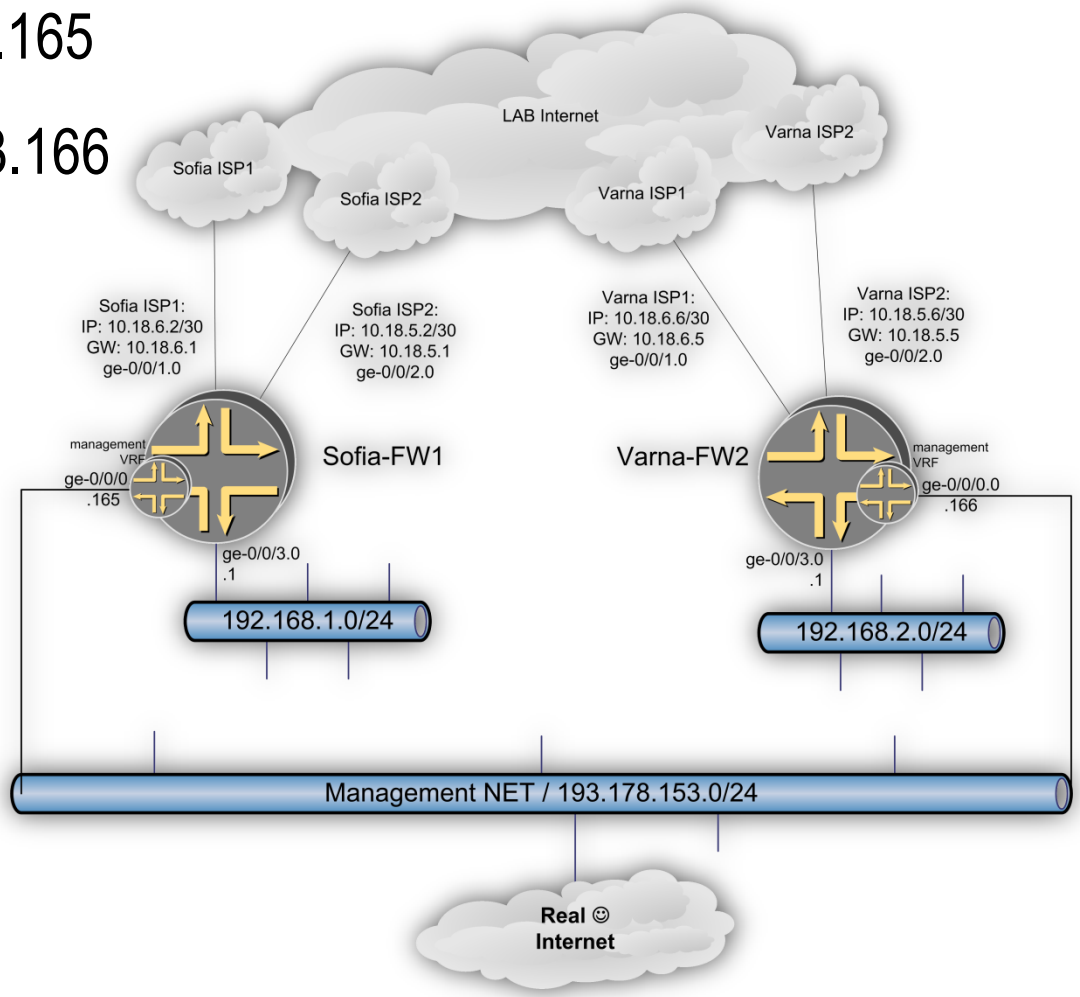
Sofia-FW1: 193.178.153.165

Varna-FW1: 193.178.153.166

user: junos

pass: Barzikt

(case-sensitive)




**Try also:**
https://193.178.153.165
https://193.178.153.166

**Note:** some stanzas are protected;
**Please, do NOT change them**


A brief history of

# JUNIPER NETWORKS


# Timeline

- 1996: Founded by Pradeep Sindhu
  - Left his job at Xerox PARC, with goal of starting up a high-end router company
- 1999: One of the most successful technology IPOs in history. Nasdaq: JNPR
- Today: Acknowledged leader in Secure and Assured Networking

# History of innovation - Juniper

- 1998: First separation of control plane & data plane
- 1998: First implementation of IPv4, v6, MPLS in silicon
- 1998: First 2.4Gbps forwarding engine
- 2000: First wire-rate 10Gbps forwarding engine
- 2002: First implementation of integrated services
- 2003: First scalable cell-switched fabric
- 2004: First multi-chassis router
- 2005: First line-rate 40Gbps forwarding engine
- 2007: First Ethernet router
- 2007: First > 160G Firewall
- 1998-2006: Record quadrupling of capacity every 2 years
- 2009: Next generation edge silicon: NISP
- 2010: First 100GE



*78 own microchip developments*

# Product portfolio Juniper Networks

## Wireless (WiFi)


WL-series

## Network Management


JUNOS Space/NSM/SRC

## Secure services

SRX-Series/ Virtual Gateway

## Core networking

T/PTX-Series

## Edge Networking

MX-Series

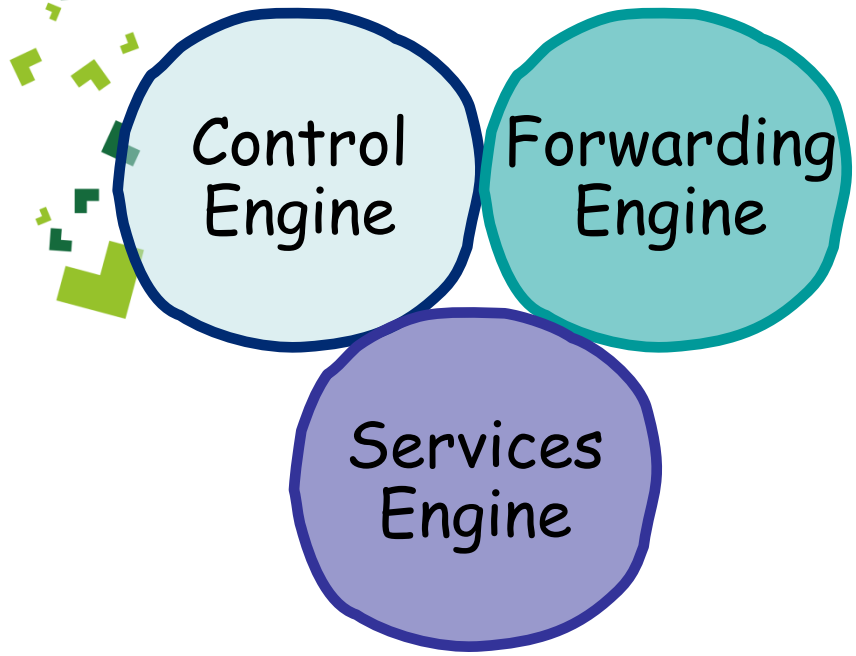
## Enterpise and Data Center Switching

EX-Series / QFX-Series

# Modular Juniper System Architecture

## A Fundamentally Different Approach

### Hardware Architecture

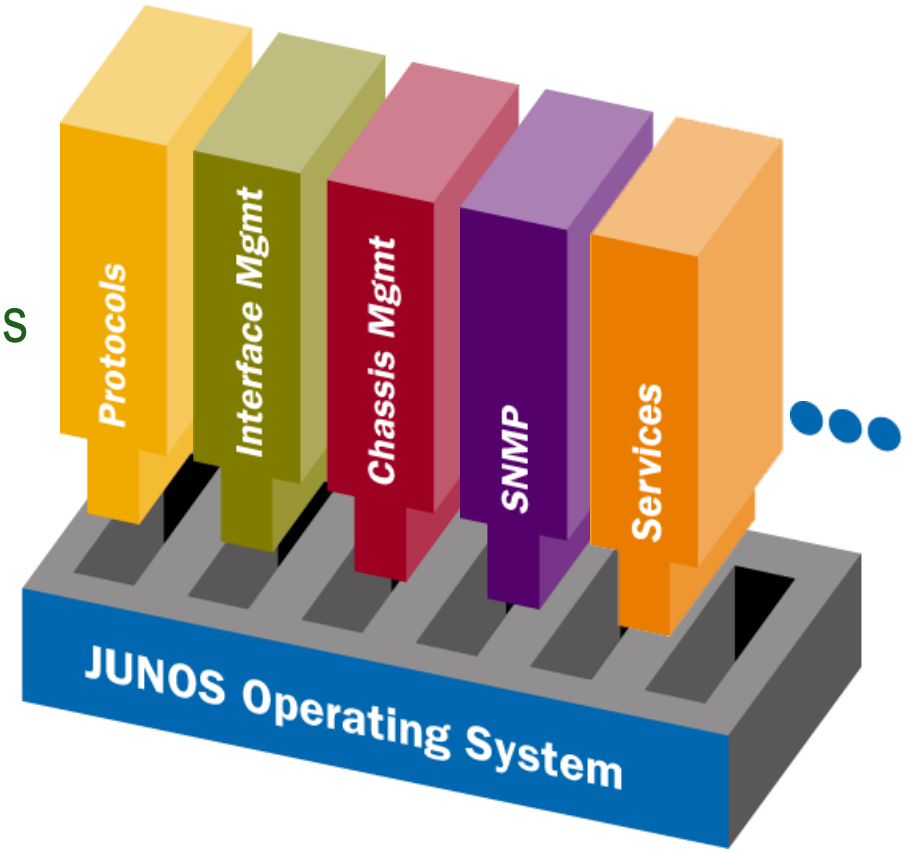



+ JUNOS®

- Guaranteed  resources per function
- Clean separation of functions

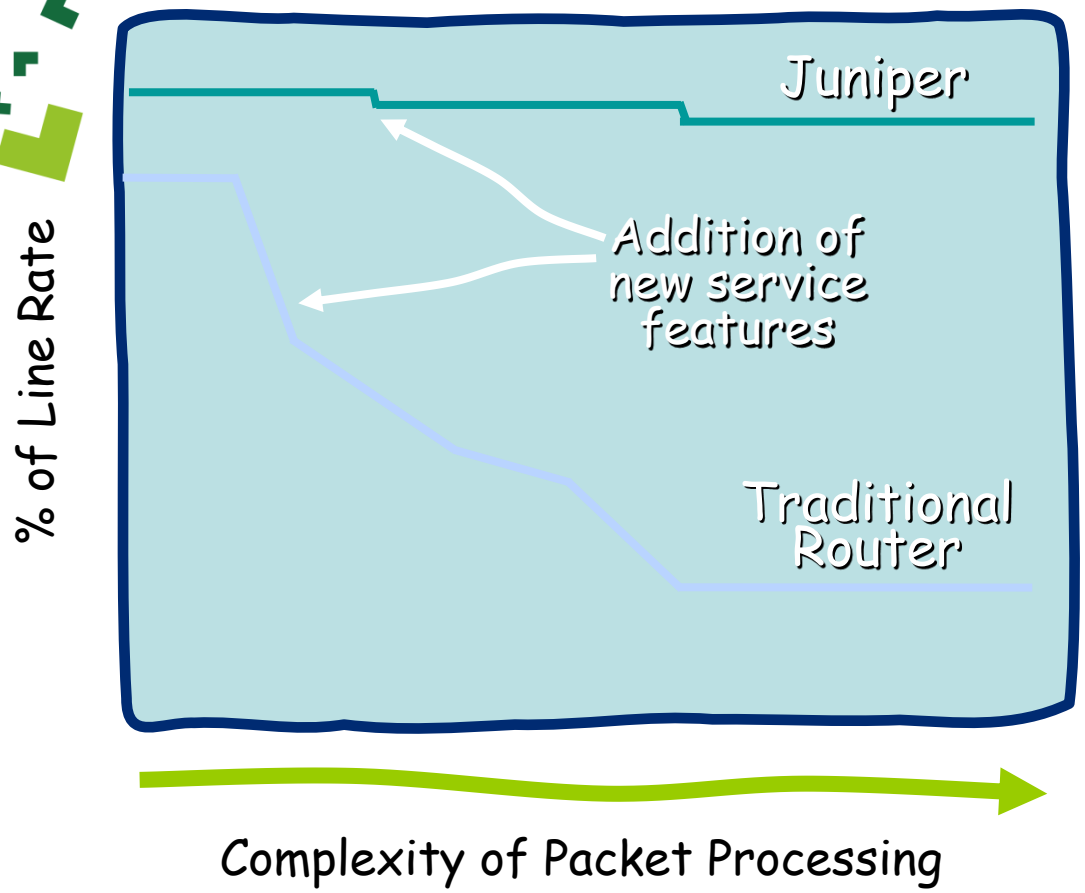
# JUNOS – A More Robust Foundation for Services

- JUNOS provides a better foundation to layer services
  - Services run in their own protected memory and can't overwrite another's
  - Single failing service does not cause a full system crash
- A failure in one service does not compromise the entire system



# Predictable Performance

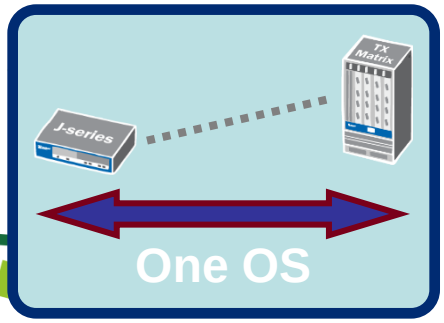
## Advanced QOS Mechanisms to Control Traffic

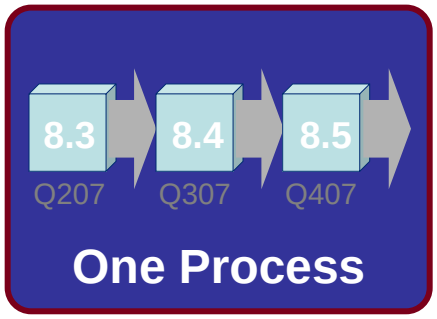


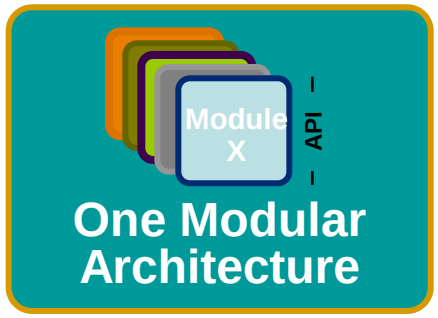

- Predictable performance, even under load
- Comprehensive QOS functions to classify, prioritize and schedule traffic
- Activate real-time performance monitoring and usage tracking without degradation

# JUNOS Software

## One Operating System for High-Performance Networks



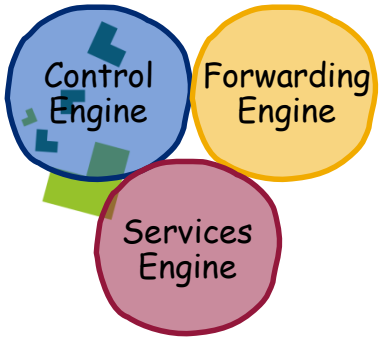




- Improving Operations Results and Costs
  - Error-resilient configuration
  - Proactive system management
  - Ease of upgrade
- Enhancing Business Continuity
  - High availability functions
  - Predictable performance
  - Secure operations
- Opening the Doors to Innovation
  - Time-tested interoperability
  - Flexible integration to existing systems

# Juniper Advantages

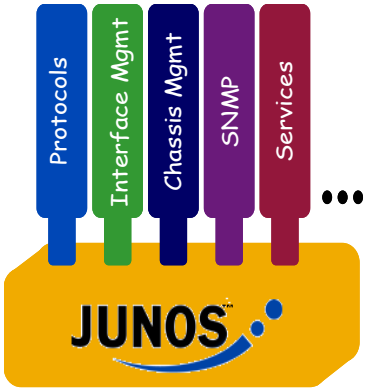
## Increased Security, Uptime, Performance, Operational Flexibility

### strong Security



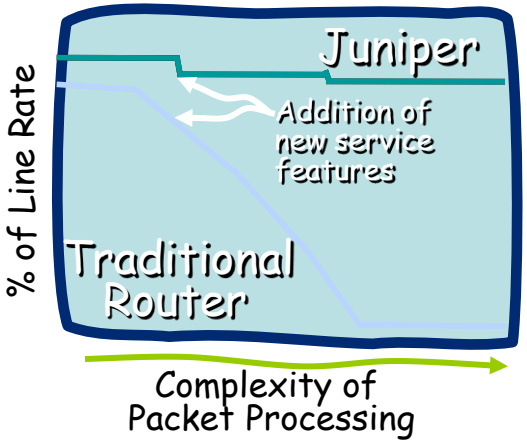

- Modularity for full router control in attack
- Next Gen CLI for fast editing of filters while under attack
- Add many filter terms without degradation

### high Uptime



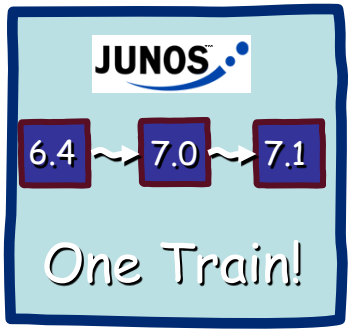

- Minor problems do not lead to system crashes
- Next Gen CLI prevents operator error
- Rescue button on J-series
- Graceful restart and M10i hitless recovery

### predictable Performance




- Predictable performance for voice, video and other time critical apps
- Comprehensive QOS functions to classify, prioritize and schedule traffic

### reduced Operations cost

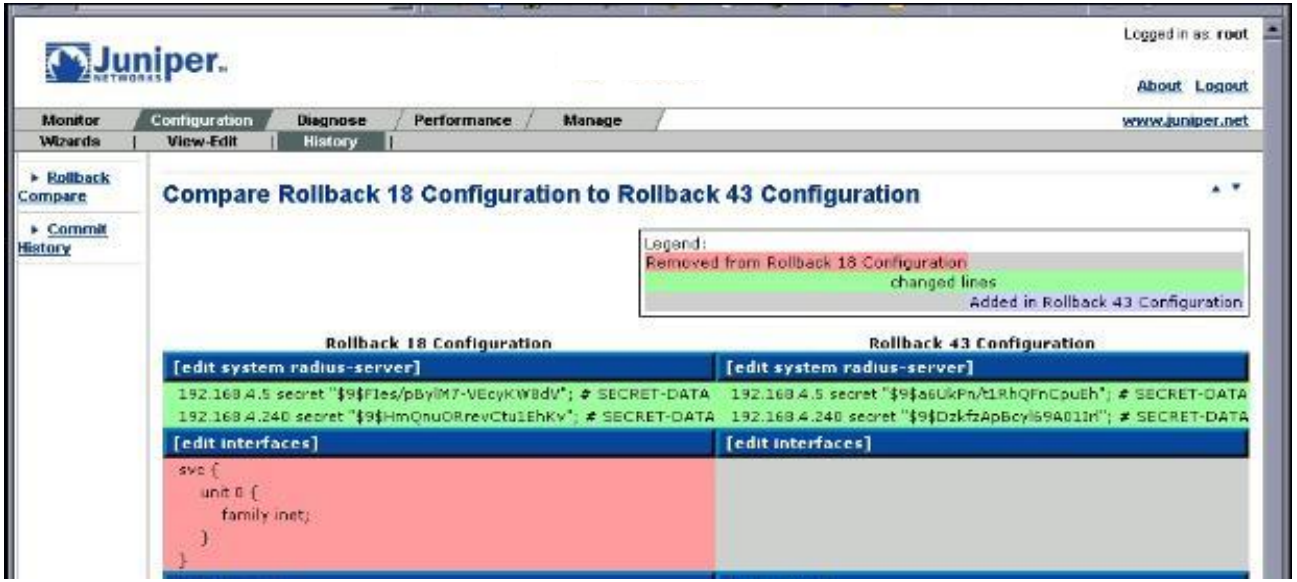



- One software train
- Multiple management tools, including J-Web
- Restoration features
- Feature licensing
- Interoperability

# High Uptime - Next Gen CLI

## Protect Network from Configuration Errors

- Commit check of candidate config verifies entire config
- Commit confirm automates rollback if problems occur
- Rollback to 50 previous configs
- Rescue button linked to a golden config in J-series
- Configuration compare between any two configs




Config compare with J-Web

# JUNOS Operational Advantage

- Reset configuration – via physical button push
- Commit confirms – rollback configs based on confirmation.
- Rollback – can store up to 50 past configs that can be rolled back to.
- Atomic updates of configs – batch update
- Backup OS support

# Control Plane Versus Data Plane

- Control Plane:
  - Implemented on the Routing Engine
  - JUNOS software kernel, daemons, chassis management, user interface, routing protocols, system monitoring, clustering control
- Data Plane:
  - Implemented on the DPCs, MPCs, IOCs and SPCs
  - Forwarding packets, session setup and maintenance, load-balancing, security policy, screen options, IDP, VPN

Login

# Login

Login in factory default state as user "root". Password is empty

```
Amnesiac (ttyd0)

login: root


**********************************************************************
** Welcome to JUNOS:                                                **
**                                                                  **
**     To run the console configuration wizard, please run the      **
**     command 'config-wizard' at the 'root%' prompt.               **
**                                                                  **
**     To enter the JUNOS CLI, please run the command 'cli'.        **
**                                                                  **
**********************************************************************


root@% cli
root>
```

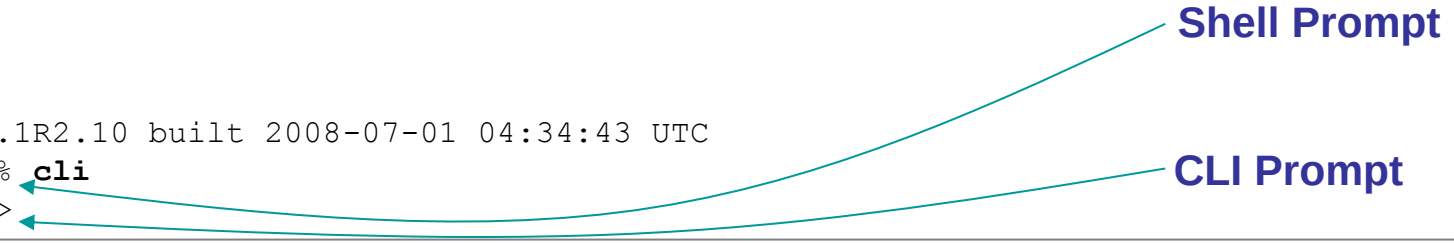
# Login

- Non root users are placed into the CLI automatically

```
switch (ttyu0)

login: user
Password:

--- JUNOS 9.1R2.10 built 2008-07-01 04:34:43 UTC
user@switch>
```

- The root user must start the CLI from the shell
  Do not forget to exit root shell after logging out of the CLI!

```
switch (ttyu0)

login: root
Password:

--- JUNOS 9.1R2.10 built 2008-07-01 04:34:43 UTC
root@switch% cli
root@switch>
```



# CLI Basics

# CLI Modes

- Shell - when you login as root

```
root%
cli
root>
```

**The % character identifies Shell mode**

- CLI - Operational Mode

```
user@switch>
```

**The > character identifies operational mode**

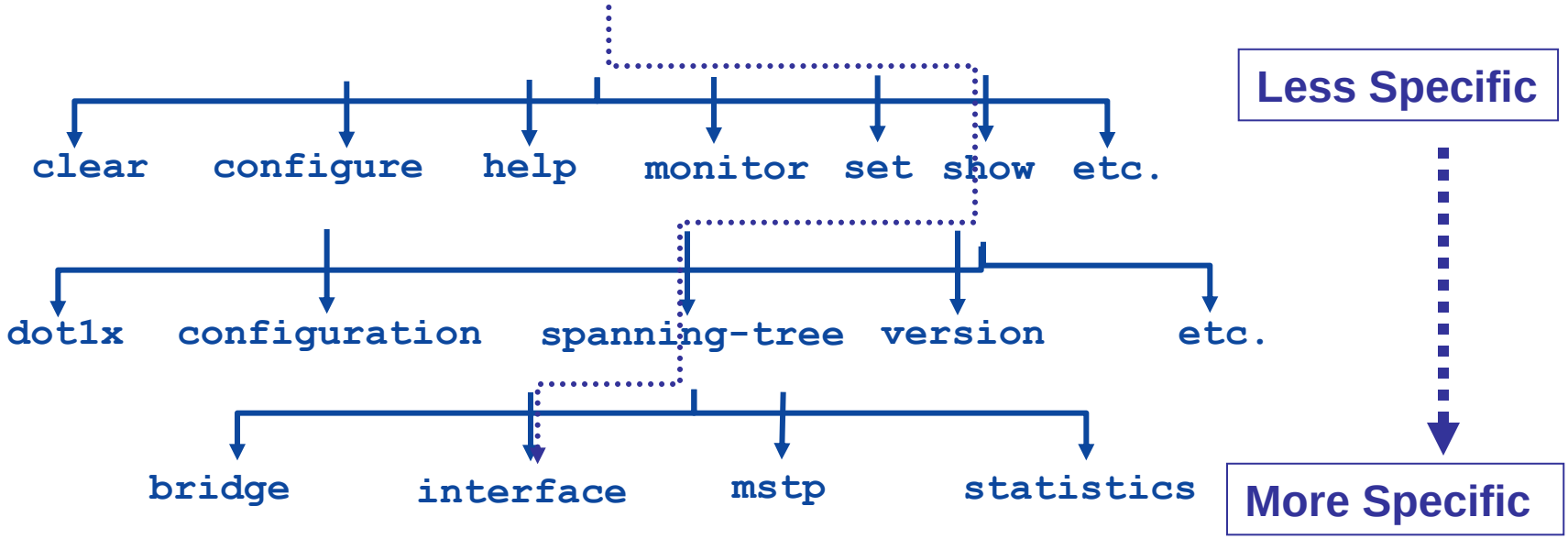
- CLI - Configuration mode:

```
user@switch> configure
[edit]
user@switch#
exit
user@switch>
```

**The # character identifies configuration mode**

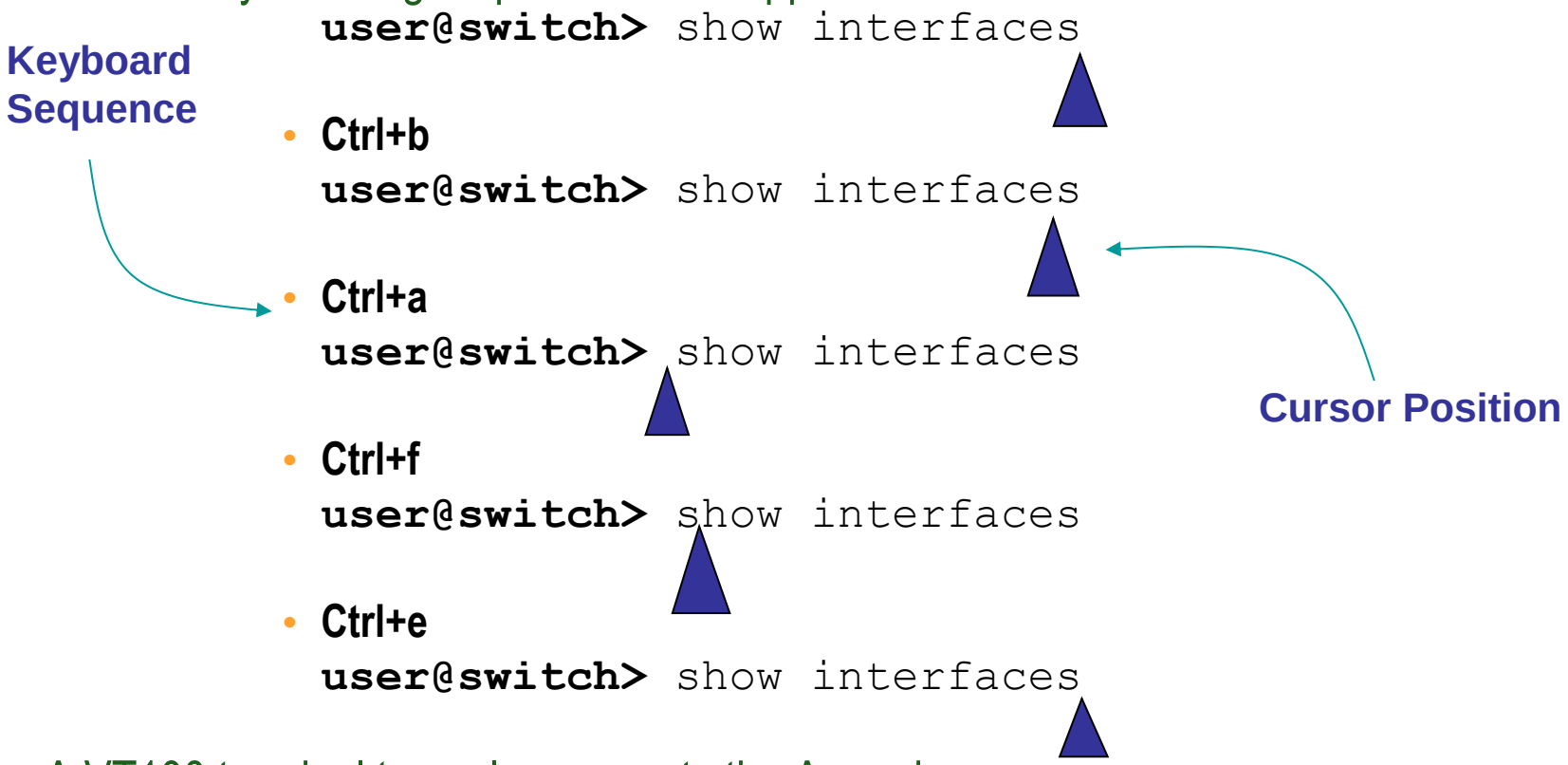
# CLI Hierarchy

- Execute commands (mainly) from the default CLI level (`user@switch>`)
  - Can execute from configuration mode with the `run` command
  - Hierarchy of commands
  - Example: `show spanning-tree interface`



# CLI Editing

- EMACS-style editing sequences are supported




- A VT100 terminal type also supports the Arrow keys

# Command and Variable Completion

- Spacebar completes a command

```
user@host> sh<space>ow i<space>
'i' is ambiguous.
Possible completions:
  igmp                 Show Internet Group Management Protocol...
  ike                  Show Internet Key Exchange information
  interfaces           Show interface information
  ipsec                Show IP Security information
  isis                 Show Intermediate System-to-Intermediate...

user@host> show i
```

**Enter a space to complete a command**

- Use the Tab key to complete an assigned variable

```
[edit policy-options]
user@host# show policy-statement t<tab>his-is-my-policy
then accept;

[edit policy-options]
user@host#
```

**Use Tab to complete assigned variables**

# Context-Sensitive Help

- Type ? anywhere on the command line

```
user@host> ?
Possible completions:
  clear                Clear information in the system
  configure            Manipulate software configuration information
  file                 Perform file operations
  help                 Provide help information
  . . .
user@host> clear ?
Possible completions:
  arp                  Clear address resolution information
  bfd                  Clear Bidirectional Forwarding Detection
                           information
  bgp                  Clear Border Gateway Protocol information
  firewall             Clear firewall counters
  . . .
```

# CLI Overview – Command output

- **All output in Junos is Unix “less”**
  - **just like “more” but with additional options**
- **Output does not scroll off the screen**

| / string – search | |
|---|---|
| n – repeat search | Enter – line |
| q – quit | h – help |
| b – previous screen | N – full listing |
| space – next screen | G – End of file |
| s – filename<br>(saves in user default directory /var/home/user) | |

**Example:**

```
show interfaces
/ lo0
```

# CLI Overview – Command History

- Command history for CLI  and configure mode

- Up / Down arrow (VT100)
- (Ctrl-P / Ctrl-N)

- show cli history  (CLI mode only)
  - Default is to show last 100 commands
  - <count> Maximum number of commands to display

# Show current Configuration

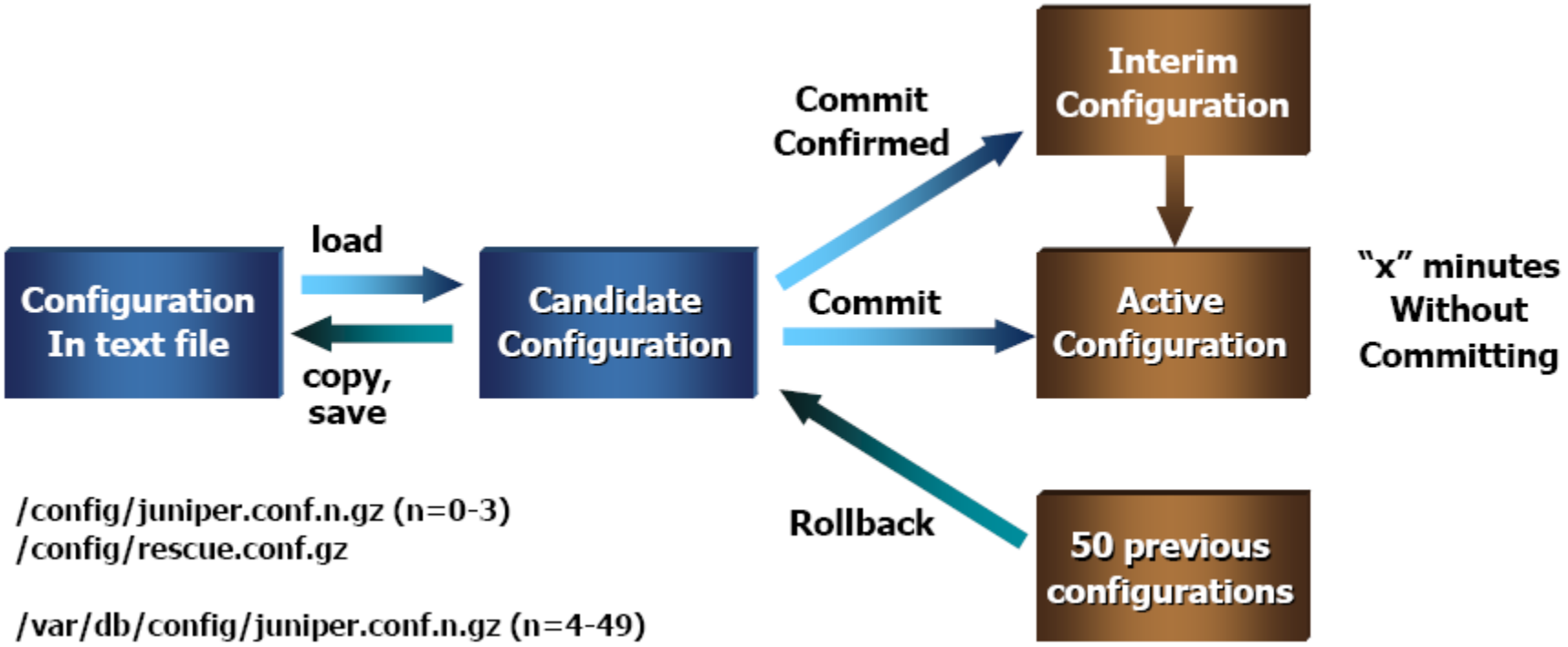
- JUNOS Style

```
root@J6350> show config
## Last commit: 2009-03-18 10:27:20 UTC by lab
version 9.3R2.8;
system {
    host-name Demo-081-111-J6350;
    root-authentication {
        encrypted-password "$1$QOLKoFKc$D/rIuLTkLP1BX9/GjQ.yN."; ## SECRET-DATA
    }
    name-server {
        172.30.80.65;
    }
    login {
        user lab {
            uid 2000;
            class super-user;
........
```

- **IOS Style**

```
root@J6350> show config | display set
set version 9.3R2.8
set system host-name J6350
set system root-authentication encrypted-password "$1$QOLKoFKc$D/rIuLTkLP1BX9/GjQ.yN."
set system name-server 172.30.80.65
set system login user lab uid 2000
set system login user lab class super-user
........
```

# Configuration, Candidate, Commit, Rollback



# Commands in Configuration Mode (1)

| Command | Function |
|---|---|
| **set** | Assigns a value to a configuration parameter. |
| **delete** | Deletes a configuration parameter. If, after deleting the parameter, the configuration statement is empty, that empty statement is removed from the configuration. |
| **show** | Displays the configuration from the current configuration hierarchy level and below. Issuing the show command from the top of the configuration hierarchy displays the entire configuration. |

# Commands in Configuration Mode (2)

| Command | Description |
|---|---|
| **copy** | • Copies the target configuration statement to a new configuration statement with a different name.<br>• Especially useful when you have many similar configuration statements.<br>• The copy command duplicates the statement and the entire hierarchy of statements under that statement.<br>• The copy command only works with configuration statements that have user-defined names. |
| **rename** | • For user-defined parameter names (such as interface names, policy statements, or firewall filters), the rename command assigns a new name to the parameter.<br>• In most cases the rename command allows you use to change a value.<br>• Many use the delete command to remove the statement and then use the set command to add the new value. |

# Copy/Paste Configurations

- To paste and override the whole configuration

```
SRX# load replace terminal
[Type ^D at a new line to end input]
system {
........
```

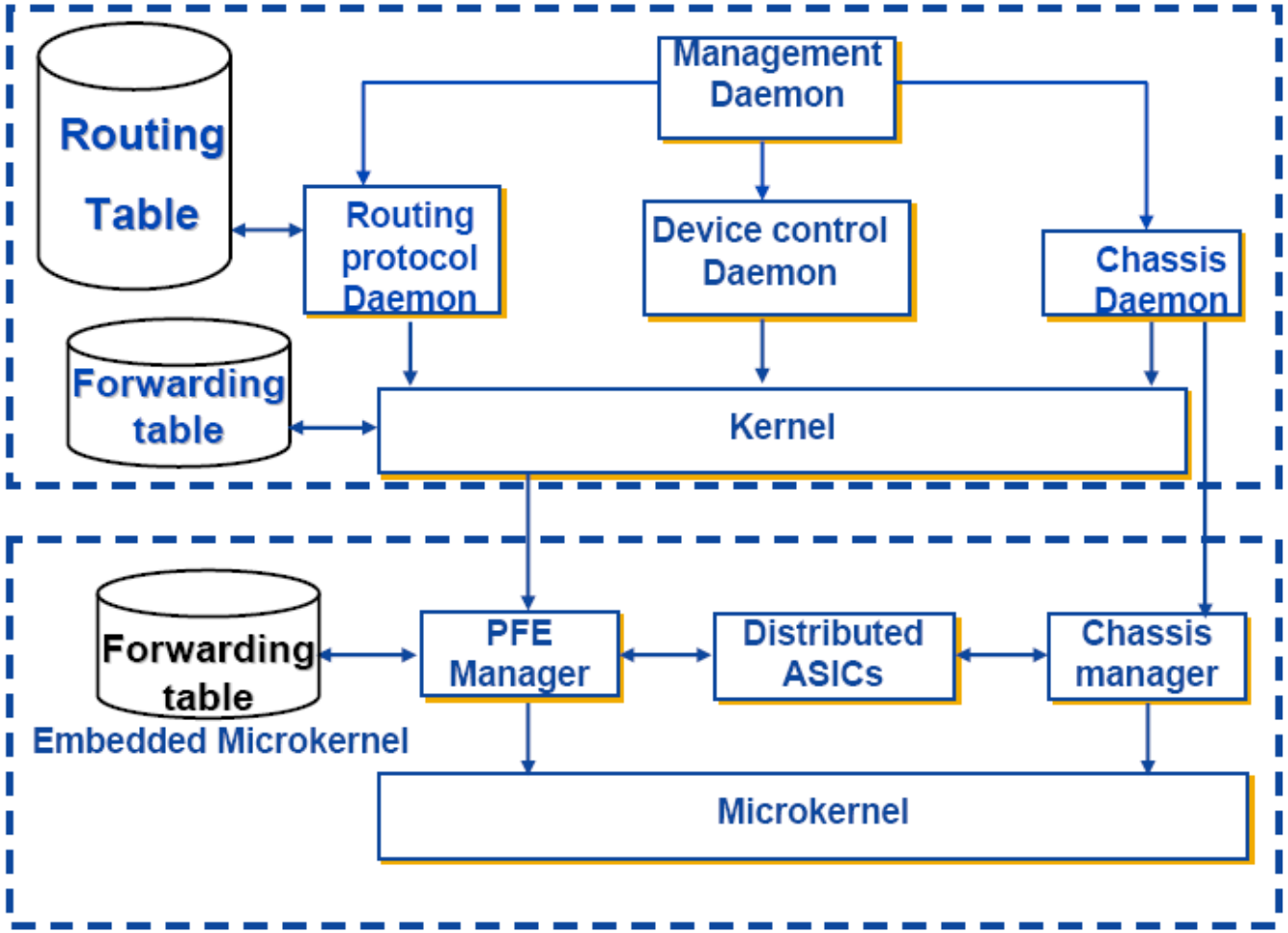
- To paste and add pieces of configuration

```
SRX# load merge terminal <relative>
[Type ^D at a new line to end input]
system {
........
```

- To paste configuration written with "set" commands

```
SRX# load set terminal <relative>
[Type ^D at a new line to end input]
set system ….
```

# Control and Forwarding Plane of a JUNOS Router



# Interfaces

# Interface Numbering

- Interfaces Names and Numbers

```
Interface name = <Interface Type>-<Slot>/<Module>/<Port>.<logical number>

All numbers start from 0

Example :
ge-0/1/2.3  -  Gigabit Interface (Slot 0, Module 1, Port 2, Logical unit 3)
fe-0/1/2.3  -  Fast Ethernet Interface
st0.0       -  First Secure Tunnel Interface (VPN Tunnel)
lo0         -  First loopback interface

For a list of Interface Types see
http://www.juniper.net/techpubs/software/JUNOS/JUNOS96/swconfig-network-interfaces/frameset.html
```

```
show interfaces ge-0/0/*
```

- Wildcards - Many commands accept wildcards in ifnames

# Switching

# SWITCHING
# BASIC CONFIGURATION

```
# By default all interfaces of an EX series switch are configured for Ethernet
switching.
user@SW-EX2200> show configuration interfaces
ge-0/0/0 {
        unit 0 {
            family ethernet-switching;
}
}
ge-0/0/1 {
        unit 0 {
            family ethernet-switching;
        }
    }
 ...

# If you need to recreate this configuration for interface ge-0/0/0, use the
following command:
user@SW-EX2200# set interfaces ge-0/0/0 unit 0 family Ethernet-switching

# A VLAN (vlan-trust) is defined to allow switching between several interfaces
user@SW-EX2200# set vlans vlan-trust vlan-id 3

# One way of configuring ports in the VLAN is by adding them to the VLAN
configuration
user@SW-EX2200# set vlans vlan-trust interface ge-0/0/0
user@SW-EX2200 # set vlans vlan-trust interface ge-0/0/1
user@SW-EX2200# set vlans vlan-trust interface ge-0/0/2
```

# SWITCHING BASIC CONFIGURATION (cont.)

```
# You can also add allowed VLAN's to the interface (using names and/or VLAN
ID's):

user@SW-EX2200> show configuration interfaces
...
ge-0/0/2 {
  unit 0 {
        family ethernet-switching {
            port-mode trunk;
            vlan {
                members [ vlan-trust vlan-untrust vlan-23 112 96 ];
            }
        }
    }
}
...
# By default all switching interfaces are in access mode (untagged)!

# If you need IP routing for this VLAN, you need to add  L3 interface:
user@SW-EX2200# set vlans vlan-trust l3-interface vlan.3
user@SW-EX2200# set interfaces vlan unit 3 family inet address 10.0.0.1/8
```

# SWITCHING
# ONE STEP FURTHER

```
# To enable Rapid Spanning Tree Protocol (RSTP), just start the protocol:
user@SW-EX2200> show configuration protocols
rstp;

# Most other advanced features are configured in the "ethernet-switching-options"
hierarchy:

user@SW-EX2200# set ethernet-switching-options ?
Possible completions:
> analyzer              Analyzer options
+ apply-groups          Groups from which to inherit configuration data
+ apply-groups-except   Don't inherit configuration data from these groups
> authentication-whitelist  MAC authentication-whitelist configuration needed to bypass
Authentication
> bpdu-block            Block BPDU on interface (BPDU Protect)
> dot1q-tunneling       Dot1q tunneling global options
> interfaces Ethernet switching family interface names
> mac-notification      MAC notification options
> mac-table-aging-time  MAC aging time configuration
> port-error-disable    Port error disable options
> redundant-trunk-group  Redundant trunk group
> secure-access-port    Access port security options
> static                Static forwarding entries
> storm-control         Storm control configuration
> traceoptions          Global tracing options for access security
uac-policy            Enable unified access control enforcement of policy
> unknown-unicast-forwarding  Set interface for forwarding of unknown unicast packets
> voip                  Voice-over-IP configuration
```

# SWITCHING TROUBLESHOOTING COMMANDS

```
# show which vlans exist and which interfaces are assigned
show vlans [detail]

# history of MACs added and removed
show ethernet-switching mac-learning-log

# Current MAC Table
show ethernet-switching table

# Current MAC Table from a certain interface
show ethernet-switching table interface fe-0/0/2
```

# Routing


# Static Routes Configuration

```
# Host Route
set routing-options static route 10.2.2.1/32 next-hop 10.1.1.254

# Network Route
set routing-options static route 10.2.2.0/24 next-hop 10.1.1.254

# Default Route
set routing-options static route 0.0.0.0/0 next-hop 10.1.1.254

# Route to an Interface
# Useful for Point-to-Point Interfaces like pppoe, vpn-tunnel, gre-tunnel
set routing-options static route 0.0.0.0/0 next-hop pp0.0
set routing-options static route 10.1.1.0/24 next-hop st0.0


# Route to another Virtual Router
set routing-options static route 10.0.0.100/32 next-table Logging.inet.0

# Example for a the Definition of the VR with name Logging referenced above
set routing-instances Logging instance-type virtual-router
set routing-instances Logging interface ge-0/0/7.0


# A network route to discard any traffic that did not hit a more specific route
# Black hole Routes could sometimes save performance for policy lookups or
# avoid rerouting in case of interfaces failures (example: VPN is down)
set routing-options static route 0.0.0.0/0 discard
```

# Static Routes
# ROUTE FAILOVER WITH IP-MONITORING (SRX only)

```
# Since 11.4 all Branch SRX support IP-Monitoring and automatic route failover
# Check out KB22052 for configuration details of an dual ISP connection with RPM for
# IP-Monitoring and Filter based Forwarding for load distribution

set services ip-monitoring policy Server-Tracking match rpm-probe Probe-Server
set services ip-monitoring policy Server-Tracking then preferred-route routing-
instances FBF-1 route 0.0.0.0/0 next-hop 2.2.2.2 ------> Installs route in the First
Routing Instance

set services ip-monitoring policy Server-Tracking1 match rpm-probe Probe-Server1
set services ip-monitoring policy Server-Tracking1 then preferred-route routing-
instances FBF-2 route 0.0.0.0/0 next-hop 1.1.1.1 ------> Installs route in Second
Routing Instance
```

# Static Routes
# MONITORING

```
# display Routing table
root@J2300> show route

inet.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[Static/5] 01:13:15
                    > to 172.16.42.1 via fe-0/0/0.0
10.2.2.0/24        *[Static/5] 00:00:05
                    > to 172.16.42.1 via fe-0/0/0.0
172.16.42.0/24     *[Direct/0] 01:13:15
                    > via fe-0/0/0.0
172.16.42.230/32   *[Local/0] 01:21:12
                       Local via fe-0/0/0.0
224.0.0.9/32       *[RIP/100] 01:21:37, metric 1
                       MultiRecv

# route lookup for a certain destination
root@J2300> show route 20.0.0.1


# routing table overview
root@J2300> show route summary

# Forwarding table (includes all active routes, visible for the data-plane)
root@J2300> show route forwarding-table
```


# OSPF CONFIGURATION

```
# enable OSPF on a interface
set protocols ospf area 0.0.0.0 interface ge-0/0/0.0
# And permit ospf traffic to this zone
set security zones security-zone host-inbound-traffic protocols ospf

# Recommended: use loopback interface
set interfaces lo0 unit 0 family inet address 192.168.1.2/32
set protocols ospf area 0.0.0.0 interface lo0.0 passive

# Option: specify your own Router-id
set routing-options router-id 192.168.1.2

# to get direct interface routes announced you can add them to OSPF in passive mode
set protocols ospf area 0.0.0.0 interface vlan.100 passive

# Option: Negotiate graceful restart
set routing-options graceful-restart

# On SRX Clusters for RG0 failover, you might have to extend OSPF Timers to survive
# a dead interval of 5-20 seconds and also use the following setting:
set protocols ospf graceful-restart no-strict-lsa-checking
```

# RIP CONFIGURATION

```
# RIP requires a group, all interface are attached to this group
set protocols rip group RIP ge-0/0/0.0
set protocols rip group RIP ge-0/0/1.0

# And permit rip traffic to the zones of these interfaces
set security zones security-zone TRUST host-inbound-traffic protocols rip

# You can add IPSEC Tunnel-Interfaces with relaxed RIP-Update-Timers
# You can even work with Tunnel-Interfaces with Next-Hop-Tunnel-Binding (NHTB)
set protocols rip group RIP neighbour st0.0 interface-type p2mp
set protocols rip group RIP neighbour st0.0 dynamic-peers
set interface st0 unit 0 multipoint

# Option: Negotiate graceful restart
set routing-options graceful-restart

# Import Routes to the RIP group via policy-options filter
set policy-options policy-statement FILTER term a from route-filter 1.2.3.0/24 exact
set policy-options policy-statement FILTER term a then accept
set policy-options policy-statement FILTER term drop then reject
set protocols rip group RIP export FILTER
```


# OSPF MONITORING

```
# See Neighbors and State
root> show ospf neighbour
Address          Interface              State     ID               Pri   Dead
10.222.2.2       ge-0/0/11.0            Full      192.168.36.1     128     36

# Link State Database
root> show ospf database
```


# OSPF IMPORT/EXPORT Filter (Policy-OPTIONS)

```
# OSPF default is to import everything (into RT) and export routes only from interfaces
# that are (active) members of the same OSPF area

# For export of all other routes or to filter inbound routes you need Routing Policy
# Filters

# Example Filter to export all local static and all direct routes
set policy-options policy-statement ALL-LOCAL
  set term 1 from protocol direct
  set term 1 then accept
  set term 2 from protocol static
  set term 2 then accept
top
set protocols ospf export ALL-LOCAL

# Example Filter to export only a certain route (which must exist on the routing table)
set policy-options policy-statement JUST-ONE
  set term 1 from route-filter 172.10.0.0/16 exact
  set term 1 then metric 10 accept
top
set protocols ospf export JUST-ONE
```

# BGP CONFIGURATION

```
# Example Configuration With Two AS
# Permit BGP traffic on the zone or interface(s) where you reach your peer(s)
set security zones security-zone trust host-inbound-traffic protocols bgp

# Recommended: use loopback interface
set interfaces lo0 unit 0 family inet address 1.1.1.2/32

# Specify your own AS and your Router-ID
set routing-options autonomous-system 1234
set router-id 1.1.1.2

# Specify Peer(s)
set protocols bgp group UPSTREAM
  set local-address 1.1.1.2
  set peer-as 64005
  set local-as 64006
  set neighbor 1.1.1.1 export BGP-EXPORT-POLICY
top

# A Policy how to export the routes
set policy-options policy-statement BGP-EXPORT-POLICY from protocol direct
set policy-options policy-statement BGP-EXPORT-POLICY then accept

# Option: Set static routes that do not redistribute
set routing-options static route 1.1.2.0/24 no-readvertise

# Option: Specify how to aggregate routes
set routing-options aggregate 1.1.1.1/20 [policy ... ]
```


# BGP MONITORING

```
show bgp neighbour
show bgp summary
show route summary

# Which routes did we receive from a neighbour
show route receive-protocol bgp <peer-ip>

# Which routes do we send to a neighbour
show route advertising-protocol bgp <peer-ip>
```


# IS-IS Configuration

```
set interfaces ge-0/0/1 unit 0 family iso
set interfaces ge-0/0/2 unit 0 family iso

set interfaces lo0 unit 0 family iso address 49.0002.0002.0002.00

set protocols isis interface ge-0/0/1.0
set protocols isis interface ge-0/0/2.0
set protocols isis interface lo0.0 passive
```

# TUNNEL INTERFACES

# Tunnel Interfaces : GRE - Generic ROUTING ENCAPSULATION

```
# Typical Use cases for GRE Tunnels are
# - OSPF over GRE with non-Juniper Routers
# - Multicast over GRE with non-Juniper Routers

set interfaces gr-0/0/0 unit 0 tunnel source 10.0.0.1
set interfaces gr-0/0/0 unit 0 tunnel destination 10.0.0.2
set interfaces gr-0/0/0 unit 0 family inet address 10.1.0.1/3
set protocols ospf area 0.0.0.0 interface gr-0/0/0.0
set security zones security-zone vpn host-inbound-traffic protocols ospf
set security zones security-zone vpn interfaces gr-0/0/0.0

# MTU Adjustments might be necessary because GRE Default MTU is ~ 9000

# When Fragementation happens in a GRE Tunnel there are two options for reassembly
# a) use IDP Inspection on the traffic leaving the tunnel
# b) since JUNOS 11.2 you can apply the following command
"set security flow force-ip-reassembly
```

# Tunnel Interfaces: LOGICAL TUNNEL

```
# Logical Tunnel can be used like a physical wire between two interfaces of an SRX
# Typical use cases are:
# - forwarding between VR in packet mode and VR in flow mode
# - forwarding between VR to apply two policies to one session
# - Intra-Lsys Traffic (all Lsys have one Tunnel to Lsys0)

# Logical Tunnel Interfaces
set interfaces lt-0/0/0 unit 0 encapsulation ethernet
set interfaces lt-0/0/0 unit 0 peer-unit 1
set interfaces lt-0/0/0 unit 0 family inet
set interfaces lt-0/0/0 unit 1 encapsulation ethernet
set interfaces lt-0/0/0 unit 1 peer-unit 0
set interfaces lt-0/0/0 unit 1 family inet

# and now use them between two VRs
set routing-instances r1 interface lt-0/0/0.0
set routing-instances r2 interface lt-0/0/0.1
```

# Tunnel INTERFACES: IP over IP

```
# This Example is used to forward all IPv6 traffic encapsulated in IPv4 to 10.19.3.1

set interfaces ip-0/0/0 unit 0 tunnel source 10.19.2.1
set interfaces ip-0/0/0 unit 0 tunnel destination 10.19.3.1
set interfaces ip-0/0/0 unit 0 family inet6 address 7019::1/126
set routing-options rib inet6.0 static route ::0/0 next-hop ip-0/0/0
```

# MULTICAST

# IPv4 MULTICAST CONFIGURATION (1)

```
# IGMP to allow Receivers to join/leave a group,
# Version1 had join only and 3 min timeout
# Version2 (Default) allows Receiver join and leave
# Version3 allows to join and select Source-IP of Sender selection
set protocols igmp interface reth2.0 version 3

# Enable PIM to communicate with Multicast Routers in the Distribution Tree
set protocols pim interface reth1.0

# Finding the Rendezvous Point
# Option 1: Static Rendezvous point on an other Router
set protocols pim rp static address 192.168.1.1

# Option 2: we are Rendezvous Point by yourself - in this case loopback int. is
best pract.
set interface lo0.0 <IP-for-RP>
set protocols pim rp local address <IP-for-RP>

# Other Options supported for RP selection: Anycast, Bootstrap, Auto-RP
# Best Practice for Multicast Routing: PIM Dense Mode with Anycast RP
# Check Technote: Multicast Implementation Guide
```

# IPv4 MULTICAST CONFIGURATION (2)

```
# Allow igmp on all interfaces where we expect receivers to join
set security zones security-zone A interfaces reth1.0 host-inbound-traffic protocols igmp
set security zones security-zone B interfaces reth2.0 host-inbound-traffic protocols igmp

# Allow PIM on all interfaces where we expect distribution Routers
set security zones security-zone A interfaces reth1.0 host-inbound-traffic protocols pim
set security zones security-zone B interfaces reth2.0 host-inbound-traffic protocols pim

# All interfaces can also be in a custom VR

# IGMP Configuration is not in VR context
set protocols igmp interface reth20.0 version 3

set  routing-instances VR-MCAST instance-type virtual-router
edit routing-instances VR-MCAST
  set interface vlan.3
  set interface vlan.10
  set interface vlan.20
  set interface vlan.30
  set protocols igmp interface vlan.20
  set protocols pim rp local address 10.0.42.110
  set protocols pim interface vlan.10
top
```

# IPv4 MULTICAST TROUBLESHOOTING

```
# Monitoring
show pim bootstrap [instance VR]
show pim interfaces [instance VR]
show pim join [instance VR]
show pim mdt [instance VR]
show pim neighbors [instance VR]
show pim rps [instance VR]
show pim source [instance VR]
show pim statistics [instance VR]

show igmp interface
show igmp output-group
show igmp statistics

show multicast route
show multicast rpf

# tcpdump to watch PIM and IGMP Packets
monitor traffic interface vlan.10 no-resolve detail size 1500 matching "pim || igmp"

# DEBUGGING
set protocols pim traceoptions file trace-pim
set protocols pim traceoptions flag all
set protocols igmp traceoptions file trace-igmp
set protocols igmp traceoptions flag all

# PIM to IGMP Proxy
show multicast pim-to-igmp-proxy
```

# IPv4 MULTICAST FURTHER INFORMATION

```
# Best Practice for Multicast Routing: PIM Dense Mode with Anycast RP
# Check Technote: Multicast Implementation Guide

# IGMP-Proxy is not available, but pim-to-igmp-proxy is available
set pim-to-igmp-proxy upstream-interface ge-0/1/0.1

# Important Hint for Multicast on SRX-Cluster:
# Disable IGMP-Snooping on the surrounding switches to avoid outages after failover


# Multicast Configuration Overview and Examples
http://www.juniper.net/techpubs/en_US/junos12.1/information-products/pathway-pages/config-guide-multicast/config-guide-multicast.html#configuration

# Dense Mode and Debugging Example
http://kb.juniper.net/InfoCenter/index?page=content&id=KB24781

# Multicast Implementation Guide (EX and MX)
http://kb.juniper.net/library/CUSTOMERSERVICE/technotes/8010062-001-EN.pdf
```

# IPv6


# IPV6 DIAGNOSTICS

```
show interface terse
# it will then shows two IPv6 IPs for each interface
# 2001:........ = global address
# fe80:x:x:x    = link local address

#
show route <table inet6.0>
show ipv6 neighbours
show ipv6 router-advertisement

# Interface Traffic monitor - filtered to IPv6 only
monitor traffic interface ge-0/0/0.0 matching ip6 size 200 detail

# ping, we use the same ping for ipv4 and ipv6
ping 2001:638:c:a057::1

# force ping with IPv6
ping inet6 www.heise.de

# traceroute, same command as for IPv4
traceroute 2001:db8:0:6:202:b300:2215:595 source 2001:db8::5

# Monitoring session table
show security flow session summary family [inet|inet6]
```

# IPV6
# DYNAMIC ROUTING WITH RIPNG

```
# Enable RIP Listener on the following interfaces
edit protocols ripng
  edit group NEIGHBORS
    set neighbour ge-0/0/0.0
    set neighbour ge-0/0/1.0
    set neighbour fe-0/0/2.0
    set neighbour fe-0/0/3.0
top

# If you want to export routes you need a route filter
edit policy-options policy-statement RIPNG-EXPORT
  set term RIPNG from protocol ripng
  set term RIPNG then accept
  set term DIRECT from protocol direct
  set term DIRECT from route-filter 2001:DB8::/32 orlonger
  set term DIRECT then accept
top

# The Route Filter must be applied to the RIPNG Group
set protocols ripng group NEIGHBORS export RIPNG-EXPORT


# Monitoring
show route receive-protocol ripng
show route advertising-protocol ripng
show route protocol ripng
```

# IPV6
# DYNAMIC ROUTING WITH OSPFv3

```
# Introduction of a loopback Interface is best practice when using Routing protocols
set interface lo0 unit 0 family inet address 10.0.0.210/32

# Specifying the router-id (as IPv4) is also recommended
set routing-options router-id 10.0.0.210

# Enable OSPF Listener on the following interfaces
edit protocols ospf3
  set area 0 interface lo0.0 passive
  set area 0 interface ge-0/0/0.0
  set area 0 interface ge-0/0/1.0
  set area 0 interface fe-0/0/2.0
  set area 0 interface fe-0/0/3.0
top

# Monitoring Commands
show ospf3 neighbour
show ospf3 overview
show ospf3 route
show ospf3 statistics
```


# IPV6
# IMPROVED SECURITY

```
# Off-link malicious IPv6 nodes may spoof Neighbor Discovery messages to poison
# the routers ND cache. To mitigate, use

set protocols neighbor-discovery onlink-subnet-only

# reload after commit is suggested to clear out any bogus neighbor entries in the cache
```

# LINK AGGREGATION AND LACP

# LINK AGGREGATION on A SINGLE UNIT

- **Configuration Example for a Aggregate Ethernet Interface**

```
# Set number of Aggregated Interfaces on this device/chassis
set chassis aggregated-devices ethernet device-count <number>

# Configure AE interfaces (ae0,ae1….)
# On High-End SRX AE can be members of family inet
# On Branch SRX AE can be members of family inet and family ethernet-switching
set interfaces <aex> unit 0 family inet address <ip address>

# Associate physical ethernet interfaces to the AE
set interfaces <interface-name> gigether-options 802.3ad <aex>

# Minimum number of Links  required for this aggregate to be UP
set interfaces <aex> aggregated-ether-options minimum-links <n>

# LACP configuration (today only supported on Branch SRX)
set interfaces <aex> aggregated-ether-options lacp passive
```


# LINK AGGREGATION ON A CHASSIS CLUSTER

## Configuration Example for a Redundant Ethernet Interface

```
# On High End SRX LAG support starts with 10.1r2,  LACP starts with 10.2r3
# On some Branch SRX LAG support starts with 10.3r2,  LACP also starts with 10.3r2
# Documentation: "Chassis Cluster Redundant Ethernet Interface Link Aggregation Groups"

set interfaces ge-1/0/1   gigether-options redundant-parent reth1
set interfaces ge-1/0/2   gigether-options redundant-parent reth1
set interfaces ge-1/0/3   gigether-options redundant-parent reth1
set interfaces ge-12/0/1  gigether-options redundant-parent reth1
set interfaces ge-12/0/2  gigether-options redundant-parent reth1
set interfaces ge-12/0/3  gigether-options redundant-parent reth1
set interfaces reth1  redundant-ether-options minimum-links 3


# From the Network Point of view, these are two independent Aggregate Interfaces.
# Only the interfaces on the active node are used for transmission


# Further LACP Configuration can be added to the reth Interface now
set interfaces reth1 redundant-ether-options lacp periodic fast
set interfaces reth1 redundant-ether-options lacp passive
set interfaces reth1 redundant-ether-options lacp active
```

# Scripting and Automation

# Automation with JUNOS scripts

- Commit Scripts
  - Enable automated compliance checks & configuration changes
    - e.g.. Reject guest VLAN tag configuration on access switch trunk ports – restrict guest access to a floor
  - Macros allow operators to simplify complex configurations and self-heal errors
    - e.g. Apply pre-defined Data+VoIP port template on any switch port that gets a description matching a particular string “data-phone”

- Operations Scripts
  - Allows custom output for diagnosis and event management
    - e.g.. Combine 2 different show commands to get a custom output for better analysis

- Event Policies & Scripts
  - Automated pre-defined responses to events creating self-monitoring networks
    - e.g.. When a switch’s trunk port goes up & down, run “show interfaces” and “show alarms” CLI, parse data, save it to a file and send this to a server

# How TO INTEGRATE SCRIPTS ?

## Activation of Commit scripts

Copy a script to the /var/db/scripts/commit directory

Enable the script by including a file statement at the [edit system scripts commit] hierarchy level (must be user from super user class).

The script will now be executed every time you do a commit

Useful: to avoid typical errors (VPN without Monitor, wrong MTU ...)

## Activation of Op Scripts

Copy the script to the /var/db/scripts/op directory

Enable the script by including a file statement at the [edit system scripts op] hierarchy level (must be user from super user class).

Now you can run the script as a command (e.g.. op status overview)

# Useful LINKS FOR AUTOMATION

Useful How-to Information is available from this Scripting Guide

http://www.juniper.net/solutions/literature/white_papers/200252.pdf

Script Library from Juniper

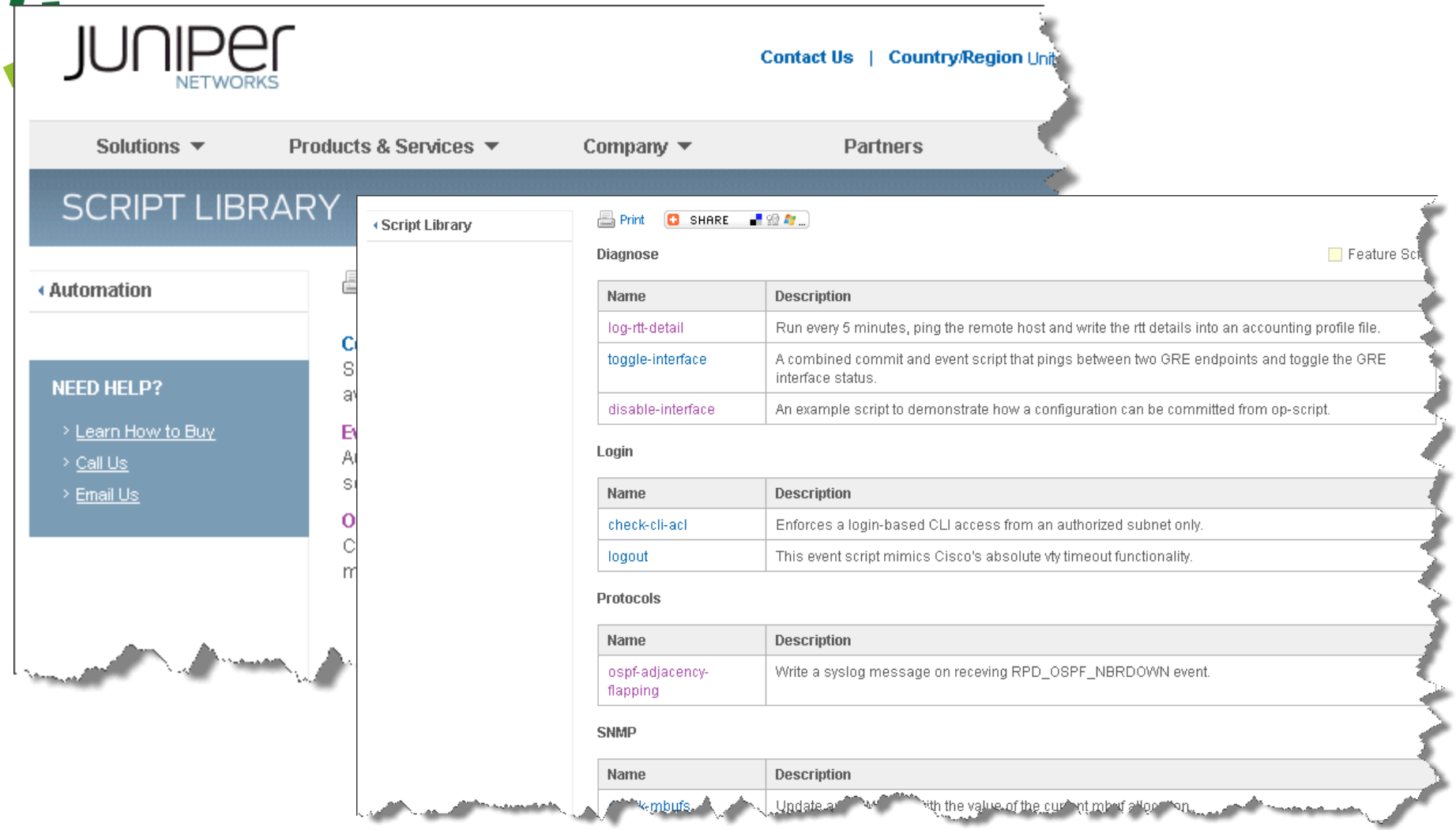
http://JUNOS.juniper.net/scripts/

Script Library on Google

http://code.google.com/p/junoscriptorium/

# SCRIPT LIBRARY

https://www.juniper.net/us/en/community/junos/script-automation/library/



Nice Features you will like .....

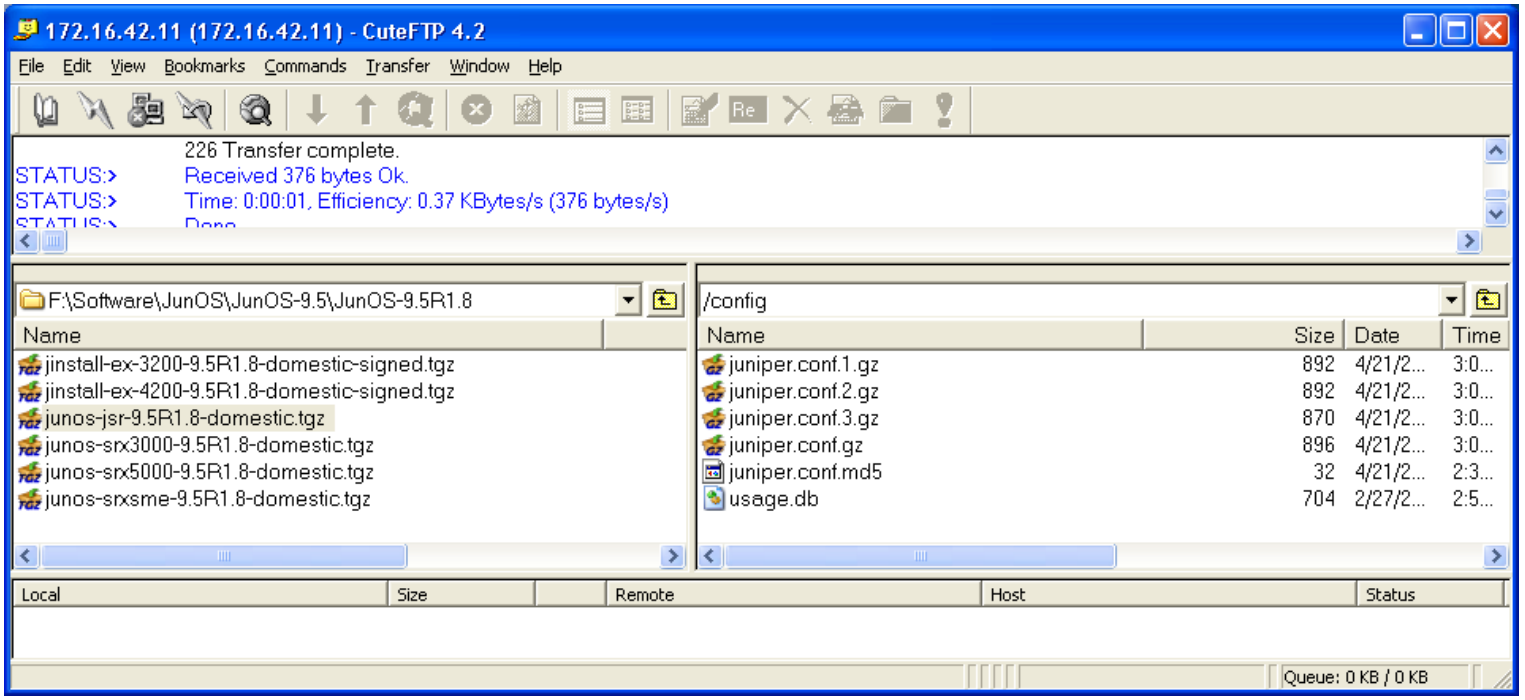
# Help is available from the CLI, EVEN without Internet

## Help available from the CLI [ topic reference apropos ]

```
# Full description of certain configuration hierarchies
root> help reference security address-book
address-book

      Syntax

   address-book {
       address address-name (ip-prefix | dns-name dns-address-name);
       address-set address-set-name {
           address address-name;
       }
   }
....


# Commands which include the word xyz
root> help apropos proxy-arp
...

# Help on certain topics
root> help topic snmp agent
...
```

# We have FTP/SCP Servers on board

```
# Start the FTP Server
set system services ftp
# Enable inbound ftp on the desired zone and/or interface
set security zones security-zone trust interfaces ge-0/0/0.0 host-inbound-traffic system-services ftp
And Connect with your favourite FTP Client
```




# Useful Extensions for Configuration Versioning

## Configuration Comments

```
# Add comment to a configuration
commit comment "Let us try this"

# List comments added during commit
show system commit
show | compare rollback ?
```

## Personal Configuration Files

```
# This will save/load configuration files in the home directory of the user
save mytestconfig.txt
load replace mytestconfig.txt
```

## Load/Save Configuration Files via FTP/HTTP

```
# load via ftp or http
load merge ftp://user:password@host/filename
load merge http://user:password@host/filename
# save via ftp or scp
show configuration | save ftp://user:password@host/filename.
show configuration | save user@host:filename.
```


# Configuration Rollback

## Automatic rollback if not confirmed within 5 minutes

```
# Automatic rollback if not confirmed within 5 minutes
commit confirmed 5

# Commit at desired time
commit at hh:mm:ss

# on SRX Clusters Rollback is only available if you entered "configure exclusive"
```

## Rollback Versions , by Default you have 5 (on SRX) to 50 (on EX)

```
rollback ?
show config | compare rollback <number>
```

## The "Rescue" Configuration

```
# Create a rescue configuration
request system configuration rescue save

# Manual rollback to rescue
rollback rescue
commit

# On J-Series press reset button for more than 5 and less than 15 Seconds
# to automatically load and commit the rescue configuration
```

# Real-time Probe and Monitoring (RPM)

RPM can track server/application reachability and latencies over the network

```
# Configure Probes for user THOMAS
# Example probe SERVER1 checks if server responds to ping
edit services rpm probe THOMAS test SERVER1
    set probe-type icmp-ping
    set target address 172.30.80.1
    set test-interval 10
top

# Example probe SERVER2 checks if Web-Server responds within 2000 msec
edit services rpm probe THOMAS test SERVER2
    set probe-type http-get
    set target url http://172.30.81.70/index.html
    set test-interval 10
    set threshold rtt 2000000
top
```

Results can be monitored from CLI or via SNMP

```
show services rpm probe-results owner THOMAS test SERVER1

show snmp mib walk 1.3.6.1.4.1.2636.3.50
```

RPM Events can also be used to trigger Event-Scripts

# Auto Archiving Configurations

Transmit a copy of the current Config file with every commit

You can use ftp, http, scp or a copy to a local file

```
[edit system archival configuration]
transfer-on-commit;
archive-sites {
  ftp://username@host:<port>url-path password password;
  http://username@host:<port>url-path password password;
  scp://username@host:<port>url-path password password;
  file://<path>/<filename>;
}
```

The Target filename is built like this:

```
<router-name>_juniper.conf[.gz]_YYYYMMDD_HHMMSS
```

It is also possible to run periodic archival

```
set system archival configuration transfer-interval [interval]
```


# More useful stuff .....

## DNS lookup and reverse lookup

```
lab@SRX3600> show host 193.99.144.85
85.144.99.193.in-addr.arpa domain name pointer www.heise.de.
lab@SRX3600> show host www.heise.de
www.heise.de has address 193.99.144.85
```

## Network Clients available on the CLI (route lookup starts in inet.0)

```
telnet, ssh , ftp, scp, ping, traceroute, mtrace
```

## Some clients can be used to pipe command output

```
monitor traffic interface count 100   |  ftp://172.16.1.1/capture.txt
```

## CLI Shortcuts

- CTRL-A takes you to the beginning of the command line
- CTRL-E takes you to the end of the command line
- CTRL-W deletes backwards to the previous space
- CTRL-U deletes the entire command line
- CTRL-L redraws the command line (in case it has been interrupted by messages, etc.)
- CTRL-R starts CLI history search, start typing and matching results will be displayed and can be executed by simply pressing ENTER

# More useful stuff .....

## Replace a pattern in the whole configuration

```
srx# replace pattern fe-0/0/7 with ge-0/0/7
```

## What have you changed so far ?

```
srx# set system host-name SRX
srx# show | compare
-   host-name srx;
+   host-name SRX;
```

## Configure exclusive (only you have access)

```
srx> configure exclusive
warning: uncommitted changes will be discarded on exit
Entering configuration mode

[edit]
srx#
```

## Check if commit is possible (but don't do it yet)

```
srx# commit check
```

# And more .....

## Add comments anywhere in the configuration

```
srx# annotate security policies from-zone trust to-zone trust "this is an
annotation"

srx# show security policies
/* this is an annotation */
from-zone trust to-zone trust {
    inactive: policy 1 {
.....
# To remove the command redo the command with an empty string
annotate .... ""
```

## Temporary deactivate sections of the configuration

```
# deactivate whatever you want, but still keep it in the configuration
deactivate protocols ospf
```

## Generate your own Events (good to combine with Event-Scripts)

```
set event-options generate-event backup-config-event time-of-day 23:30:00
```

# And more .....

## apply-groups to

```
set groups sonet interfaces <so-*> sonet-options rfc-2615
set apply-groups sonet
```

## Copy a file from one cluster member to the other

```
file copy /var/tmp/test node1:/var/tmp/sampled.test
```

## Show Configuration with Details

```
# Use this command to get explanations and range information for each parameter
show configuration | display detail
```

## Login Messages

```
# To make a message appear before login
set system login message " Welcome \n to \n JUNOS Training\n "
# To make a message appear after successful authentication
set system login announcement "Maintenance scheduled 11PM to 2AM tonight"
```


# And more .....

## Get a timestamp on the CLI every time you execute a command

```
set cli timestamp
# To disable
set cli timestamp disable
```

## Quick Navigation in Configure Mode

```
# if you used edit to change your current path in the navigation tree you
# can still reach every leaf of the tree by using "top" at the beginning
# Tab completion works and this "top" does not change your current position

edit protocols ospf
top show interface ge-0/0/0
top set interface ge-0/0/0 unit 0 ...
```

# Further Useful Information

# Documentation and additional Sources

- Software Documentation for SRX and J-Series
  http://www.juniper.net/techpubs/software/JUNOS/
- Hardware Documentation for SRX und J-Series
  http://www.juniper.net/techpubs/hardware/srx-series.html
  http://www.juniper.net/techpubs/software/jseries/
- The JUNOS Page
  http://JUNOS.juniper.net/
- JTAC Knowledgebase
  http://kb.juniper.net/
  SRX Channel: http://kb.juniper.net/index?page=content&cat=SRX_SERIES&channel=KB
- User Forums
  http://forums.juniper.net/jnet/
  http://www.juniperforum.com/
- Books
  http://www.juniper.net/us/en/training/jnbooks/

# Self Service Trainings

Training: Fasttrack Program (free materials)

http://www.juniper.net/training/fasttrack/

Training: Complete List of all Training and E-Learning Offers

http://www.juniper.net/us/en/training/technical_education/

Training: JUNOS as a second language

http://www.juniper.net/us/en/training/elearning/jsl.html

Training: Virtual Labs for Partner (Hands-on if you have no HW)

https://www.juniper.net/partners/partner_center/common/training/virtual_lab.jsp

Training: JTAC Webcasts for Partner

https://www.juniper.net/partners/partner_center/common/training/post_sales_webcasts.jsp

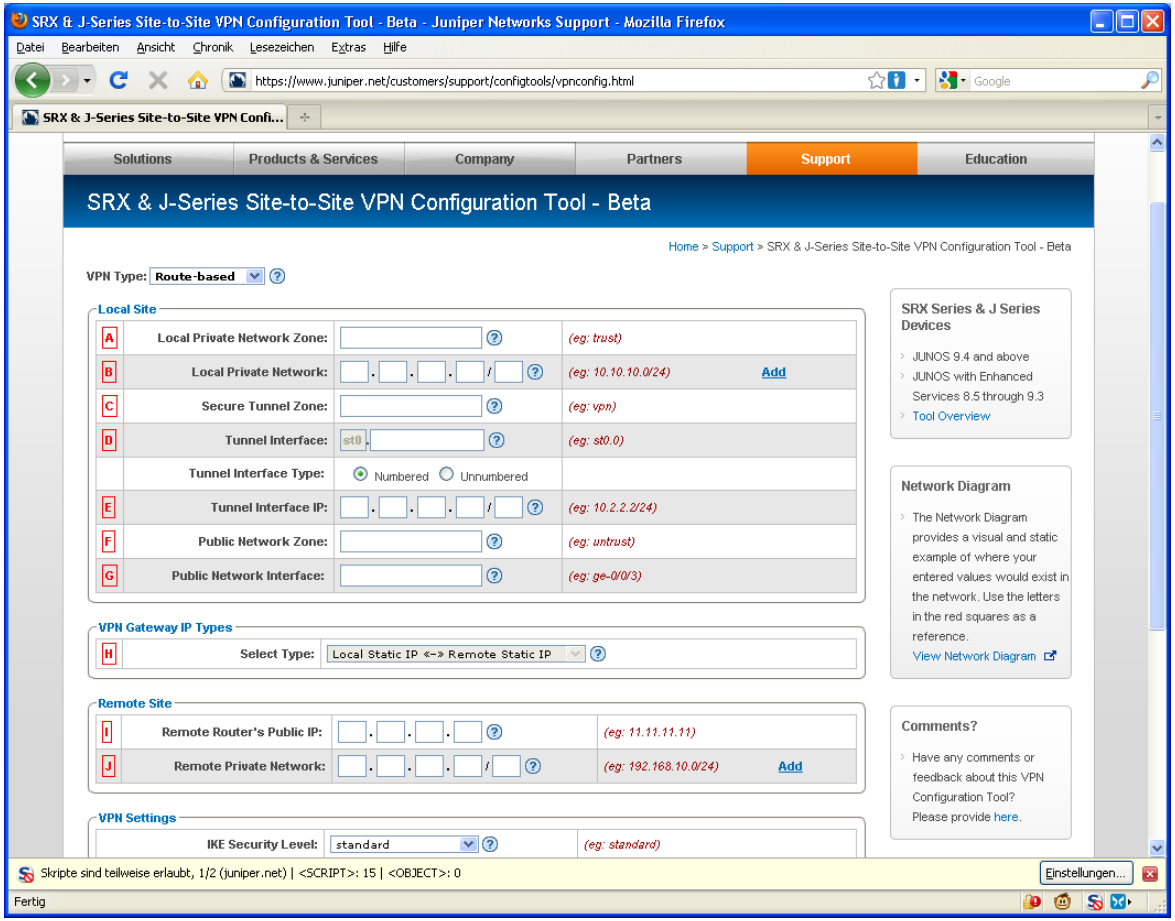
Discount Vouchers for Certifications

http://JUNOS.juniper.net/prometricvoucher/

# VPN Configuration Generator

- Generator for VPN Configurations (route and policy based)

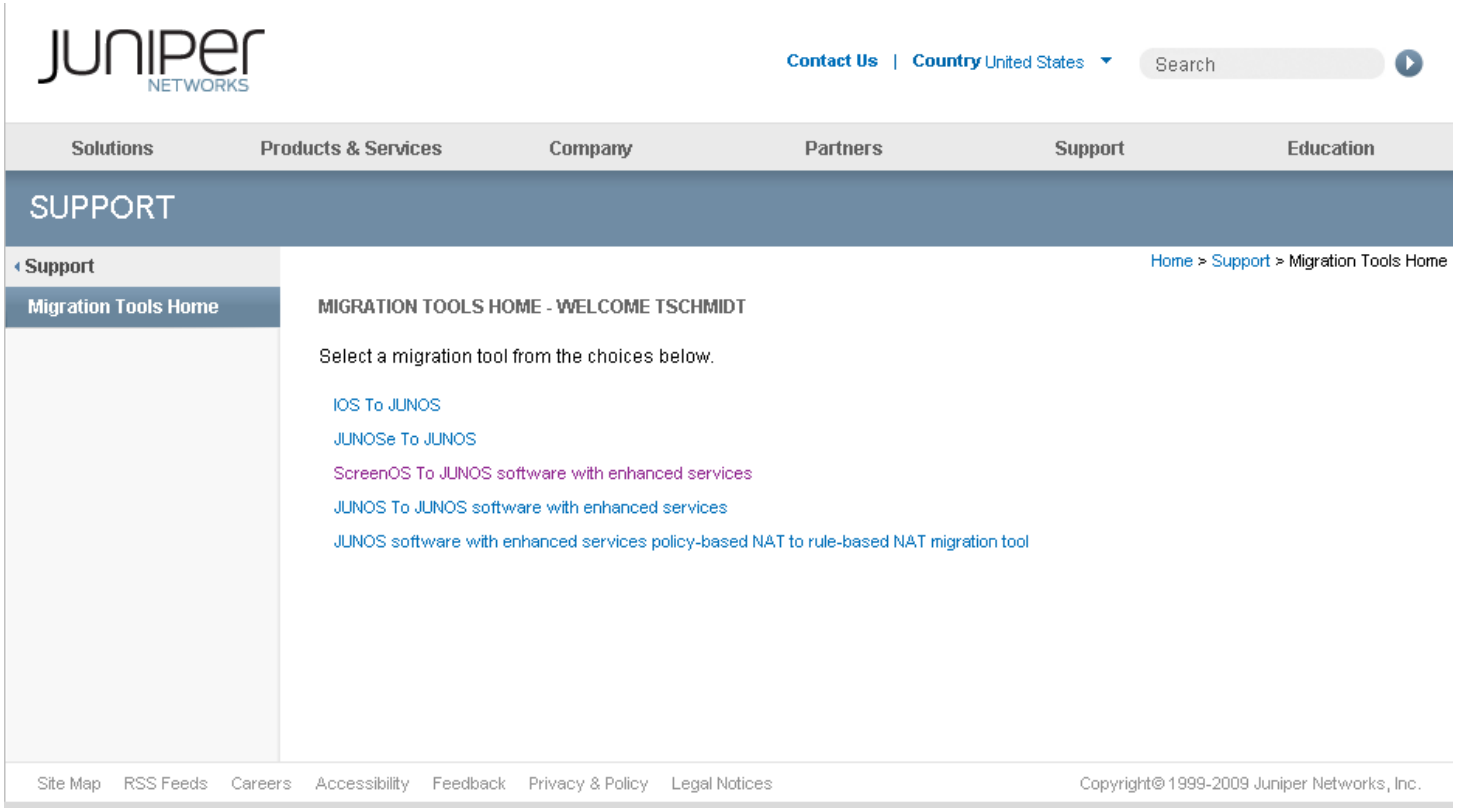
https://www.juniper.net/customers/support/configtools/vpnconfig.html



# Migration Tools

- Convert Cisco or Netscreen configurations to JUNOS

https://migration-tools.juniper.net/tools/index.jsp



# Additional Useful Information Sources

Day One Booklets
http://www.juniper.net/us/en/community/junos/training-certification/day-one/

Feature Explorer and Content Explorer
http://pathfinder.juniper.net/feature-explorer/
http://www.juniper.net/techpubs/content-applications/content-explorer/

Feature Support Reference Guide
https://www.juniper.net/techpubs/en_US/junos12.1/information-products/pathway-pages/security/feature-support-reference.html?chap-feature-support-tables.html

SRX Knowledgebase (Jump Station)
http://kb.juniper.net/KB15694

SRX Knowledgebase (Here a list of the latest SRX articles)
http://kb.juniper.net/index?page=content&cat=SRX_SERIES&channel=KB

SRX Application Notes
http://www.juniper.net/us/en/products-services/security/srx-series/#literature

JUNOS Network Configuration Examples
http://www.juniper.net/techpubs/en_US/junos/information-products/pathway-pages/nce/index.html

Juniper Forum

- Configuration Library http://forums.juniper.net/t5/Configuration-Library/bd-p/ConfigLib
- DayOne Tips http://forums.juniper.net/t5/Day-One-Tips-Contest/bd-p/DayOneContest

# QUIZ

# Question 1 – 3rd award

- Which operational command you will execute to quickly verify the status of all interfaces on a Junos device?

A. show interfaces terse

B. show interfaces ip brief

C. show interfaces

D. show configuration interfaces

E. show interfaces extensive

# Question 2 – 2nd award

- Which statement is true about route preference?

A. A lower preference is better than a higher preference.

B. A higher preference is better than a lower preference.

C. It must be assigned manually for each protocol.

D. It is the same as a route metric.

# Question 3 – 1st award

- What does the 240 stand for on the default route?

```
root@SW1> show route

inet.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[Static/240] 00:01:22
                    > to 172.16.22.254 via me0.0
172.16.22.0/24     *[Direct/0] 1d 11:24:06
                    > via me0.0
172.16.22.120/32   *[Local/0] 1d 11:24:06
                       Local via me0.0
224.0.0.22/32      *[IGMP/0] 2d 15:59:17
                       MultiRecv

root@SW1>
```

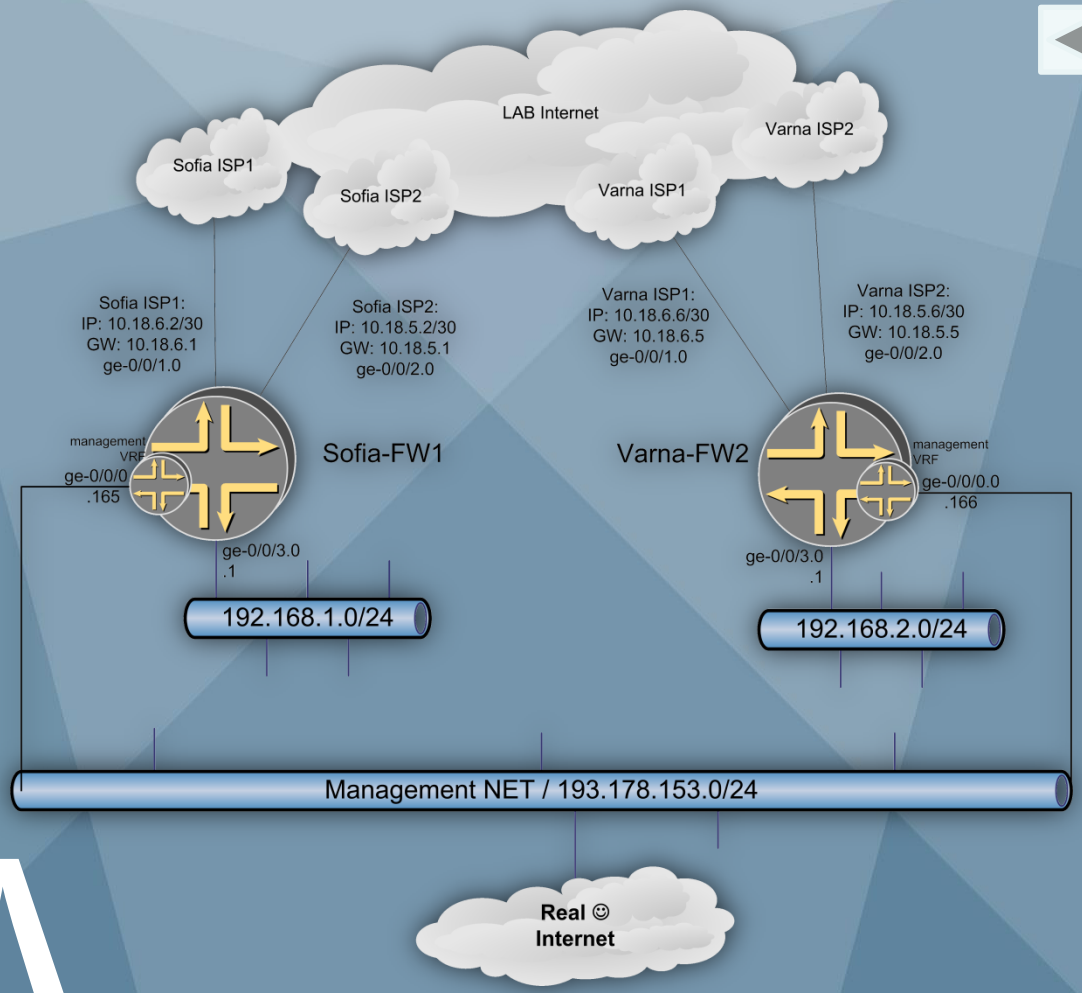
A. Hops

B. Metric

C. Preference

D. Administrative distance

# Q&A


LAB Internet
Sofia ISP1
Sofia ISP2
Varna ISP1
Varna ISP2
Sofia ISP1:
IP: 10.18.6.2/30
GW: 10.18.6.1
ge-0/0/1.0
Sofia ISP2:
IP: 10.18.5.2/30
GW: 10.18.5.1
ge-0/0/2.0
Varna ISP1:
IP: 10.18.6.6/30
GW: 10.18.6.5
ge-0/0/1.0
Varna ISP2:
IP: 10.18.5.6/30
GW: 10.18.5.5
ge-0/0/2.0
management VRF
ge-0/0/0 .165
Sofia-FW1
ge-0/0/3.0 .1
192.168.1.0/24
Varna-FW2
management VRF
ge-0/0/0.0 .166
ge-0/0/3.0 .1
192.168.2.0/24
Management NET / 193.178.153.0/24
Real ☺ Internet