RSR04E/08E

2005-8

Ā RSR JUNOS 7.3
˩ RSR JUNOS
JUNOS documentation CD

RSR JUNOS

JUNOS Configuration Guides
Feature Guide
JUNOS-FIPS
MPLS Applications
Multicast
Network Interfaces and Class of Service
Network Management
Policy Framework
Routing and Routing Protocols
Services Interfaces
System Basics
VPNs

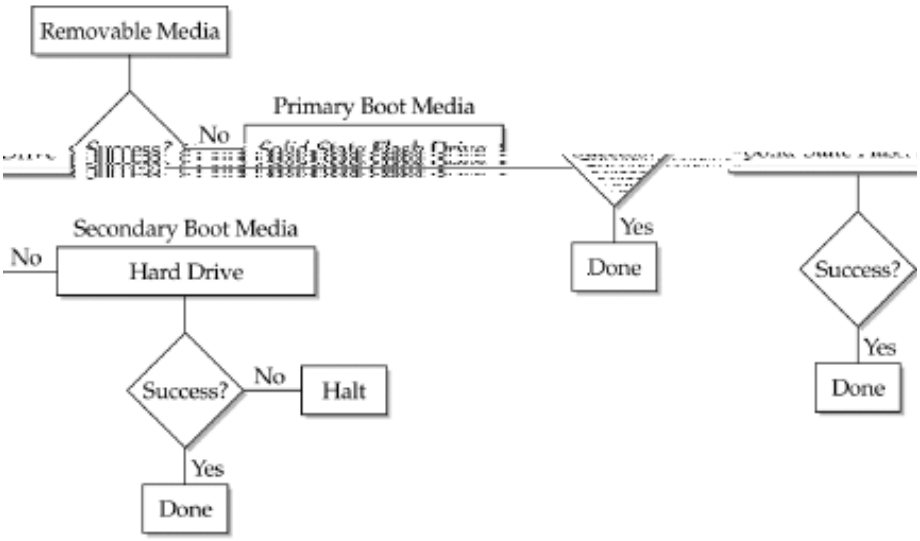
1¨ JUNOS

Junos FreeBSD IPv6 à
MPLS ╖ Â

1-1

1.1

╟ PC-card PCMCIA Â
Flash Disk Â
Ь, IDE Â



1-2

RSR ﾍ IDE flash disk à pc-card ﾍﾊ Â ÿ IDE^ ˜ ╠ Â

1.2

1.2.1 RSR

*** FINAL System shutdown message from root ***
System going down IMMEDIATELY

Shutdown NOW!
[pid 4050]

The operating system has halted.
Please press any key to reboot.

1, “The operating system has halted. ” ˧ Ꮑ Â
2 ╟ Âľ Please press any key to reboot. Ŀ

(2) ÿ
root>**request system reboot**
Reboot the system ? [yes,no] (no)**y**

1.2.3

Junos .tgz Â ˩ ˈ jinstall-7.1r1.4-domestic.taz
ˆ 1˜ FTP Э RSR /var/home/admin/Ю
ἑ admin ˩ Â
ˆ 2˜ ʢ **request system software add** <path-and-name-for-package> Â
ÿ ╟ Â
admin@rsr04e>**request system software add** jinstall-7.1r1.4-domestic.taz
installing package ‘/var/home/admin/ jinstall-7.1r1.4-domestic.taz’….
….
Restarting cli
cli

1.3 junos

admin@rsr04E> **help reference | topic**
example: admin@1> **help topic interfaces lo0**
Configuring the Loopback Interface

On the routing platform, you can configure one physical loopback interface, lo0, and one or more addresses on the interface. To do this, include the following statements at the [:

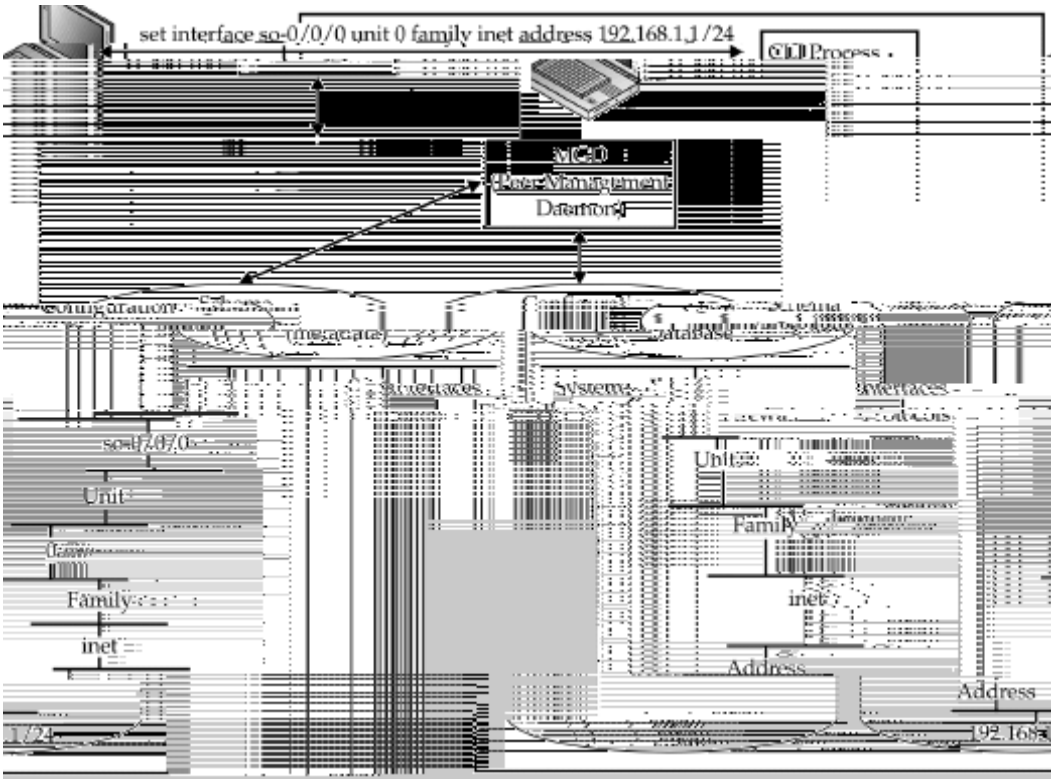
```
[edit interfaces]
lo0 {
    unit 0 {
        family inet {
            address loopback-address;
            address <loopback-address2>;
            ...
        }
    }
}
```

When do not include a destination prefix.
Also, in most cases, do not specify a loopback address on any unit other than unit 0.

```
+-------------------------------------------------------------------------+
|       | NOTE: For Layer 3 vyou can          |
|       | configure multiple logical units for the loopback interface.      |
---(more)---
```

2. JUNOS CLI

junos MGD cli ¸ Â



2-1

Example '
set interfaces fe-0/0/0 unit 0 family inet address 192.168.1.1/24
delete interfaces fe-0/0/0 unit 0 family inet address 192.168.1.1/24

2.1 CLI

1

à Â

2

test@lab2>

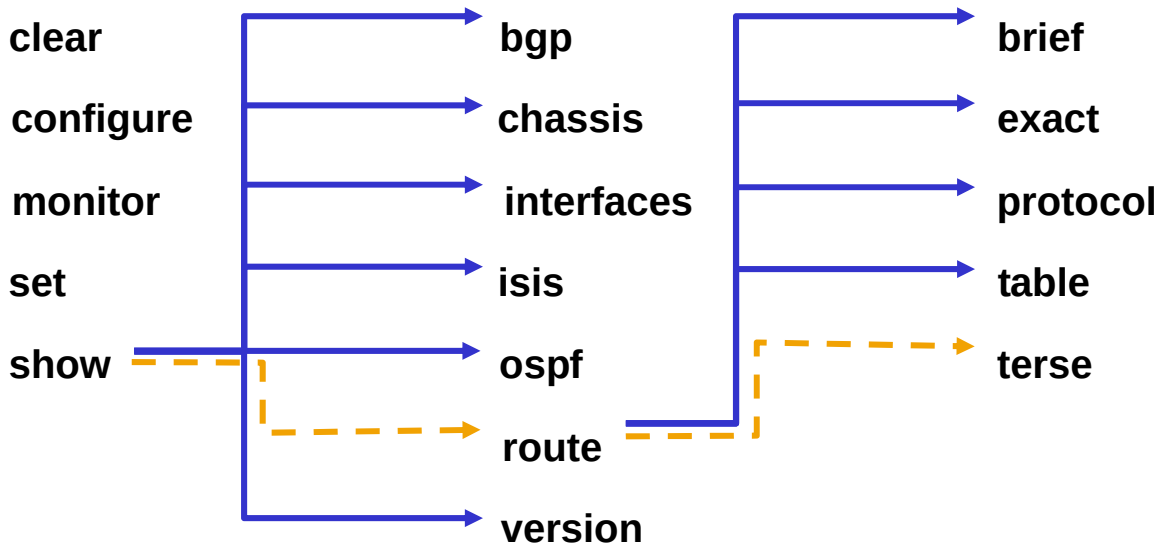
' interface à à à à Â

test@lab2> configure
[edit]
test@lab2#

2.1.1 CLI

ˆ 1˜ ϛ

tu



2-2

ˆ 2˜ ў ϛ

admin@RSR> ?
Possible completions:

clear	**Clear information in the system**
configure	**Manipulate software configuration information**
file	**Perform file operations**
help	**Provide help information**
monitor	**Show real-time debugging information**
mtrace	**Trace multicast path from source to receiver**
ping	**Ping remote target**
quit	**Exit the management session**
request	**Make system-level requests**
restart	**Restart software process**
set	**Set CLI properties, date/time, craft interface message**
show	**Show system information**
ssh	**Start secure shell on another host**
start	**Start shell**

telnet	**Telnet to another host**
test	**Perform diagnostic debugging**
traceroute	**Trace route to remote host**

ˆ 3˜ ⊣ ⎍ Ю /ⵏ |

|compare à| count à| display à| except à| find à| hold à| match à| no-more à| resolve à| save à| trim

ˆ 4˜ set cli ⵒ cli

admin@HBLF-PA-RT01> **set cli ?**
Possible completions:

complete-on-space	Toggle word completion on space
directory	Set the CLI's working directory
idle-timeout	Set the CLI maximum idle time
prompt	Set the CLI command prompt string
restart-on-upgrade	Set CLI to prompt for restart after a software upgrade
screen-length	Set number of lines on screen
screen-width	Set number of characters on a line
terminal	Set terminal type

ˆ 5˜ VT-100

Ctrl+P	Displays the previous line in the CLI history buffer and is equivalent to the Up arrow key.
Ctrl+N	Displays the next line in the CLI history buffer and is equivalent to the Down arrow key.
Ctrl+B	Moves the cursor back one character and is equivalent to the Left arrow key.
Ctrl+F	Moves the cursor forward one character and is equivalent to the Right arrow key.
Esc+B	Moves the cursor back one word at a time. The Esc key must be released and re-pressed for each keystroke.
Esc+F	Moves the cursor forward one word at a time. The Esc key must be released and re-pressed for each keystroke.
Ctrl+A	Moves the cursor to the beginning of the current command line.
Crtl+E	Moves the cursor to the end of the current command line.
Ctrl+W	Deletes the word to the left of the cursor.
Ctrl+X	Deletes the entire current command line.
Ctrl+L	Redraws the current command line

ˆ 6˜

root@lab2> **sh<space>ow i<space>**
'i' is ambiguous.

Possible completions:

igmp	Show information about IGMP
interfaces	Show interface information
isis	Show information about IS-IS

root@lab2> **show i**

ˆ 7˜

lab@omaha> **?**
Possible completions:

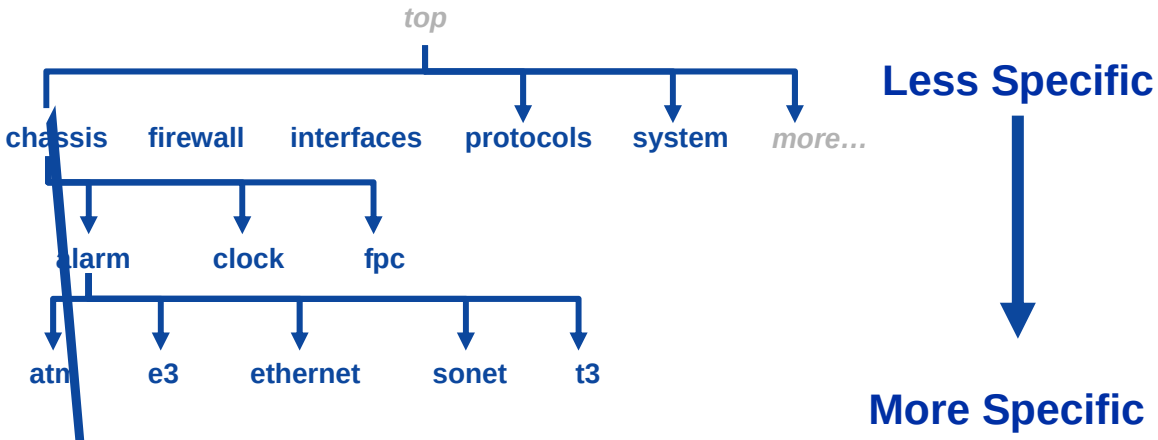
clear	Clear information in the system
configure	Manipulate software configuration information
file	Perform file operations
help	Provide help information
…	

2.1.2

ˆ 1˜

root@lab2> **configure**
Entering configuration mode
[edit]

ˆ 2˜



2 -3

ˆ 3˜ edit ȝ cd ȝ

2-4

edit chassis alarm ethernet ↲ ⎍ ethernet a set chassis alarm ethernet Â

ˆ 4˜ up top ȝ

user@host# **up**
[edit chassis alarm]
user@host# **top**
[edit]

2 – 5

```
        sonet {
+               lol red
                los red;
-               pll yellow;
        }
}
```

user@host# **s2i*D26(o | compa(r)11( )]TJ/T30 1 Tf0.0006 Tc 0 Tw76.086 0 Td[filens)8ame**

ˆ 9˜

¸ **commit** Â **rollback** Â

ser@host#**commit**

and-quit ╖

at ㎞ ㅅ commit

check a ㄴ c o m m i t

3 L

3.1 Root

3.1.1

router root ѝ
login: **root**
Password:

--- JUNOS 7.3B1.1 built 2005-04-22 22:04:30 UTC
Terminal type? [vt100]

root% **cli**
root>

root> **configure**
Entering configuration mode

[edit]
Root#

3.1.2 root

(1)
root# **set root-authentication plain-text-password**
root# new password : star
root# retype new password: star
(2) Л
root# show
root-authentication {
encrypted-password "1xavDeUe6$fNM6olGU.8.M7B62u05D6."; # SECRET-DATA
}
ˆ 3˜ è ╗ ╗ root user Â
root# set **root-authentication encrypted-password** character-string
╗ a Â

3.2 user

Junos user

3.2.1 user

root# **set login user** *robert*
root# **set login user robert authentication plain-text-password**

routing Can view routing configuration
routing-control Can modify routing configuration
secret Can view secret configuration
secret-control Can modify secret configuration
security Can view security configuration
security-control Can modify security configuration
shell Can start a local shell
snmp figuration
snmp-control Can modify SNMP configuration
system Can view system configuration
system-control Can modify system configuration
trace Can view trace file settings
trace-control view Can view current values and statistics
view-configuration Can view all configuration (not including secrets)
[edit system]
Example : root@RSR04E-1# **set login class test permissions** *[clear network reset trace view configure interface-control]*

2 class

root@RSR04E-1#**set login class test permissions** *[clear network reset trace view configure interface-control]* **allow-commands** *"system request reboot"* **deny-commands** *"(show system | show chassis | show version)"*

3, session timeout
root@RSR04E-1# s**et login class** class-name **idle-timeout** minutes;

4, RADIUS TACACS+

3.3 services and processes

3.3.1 host name à dns à domain-name

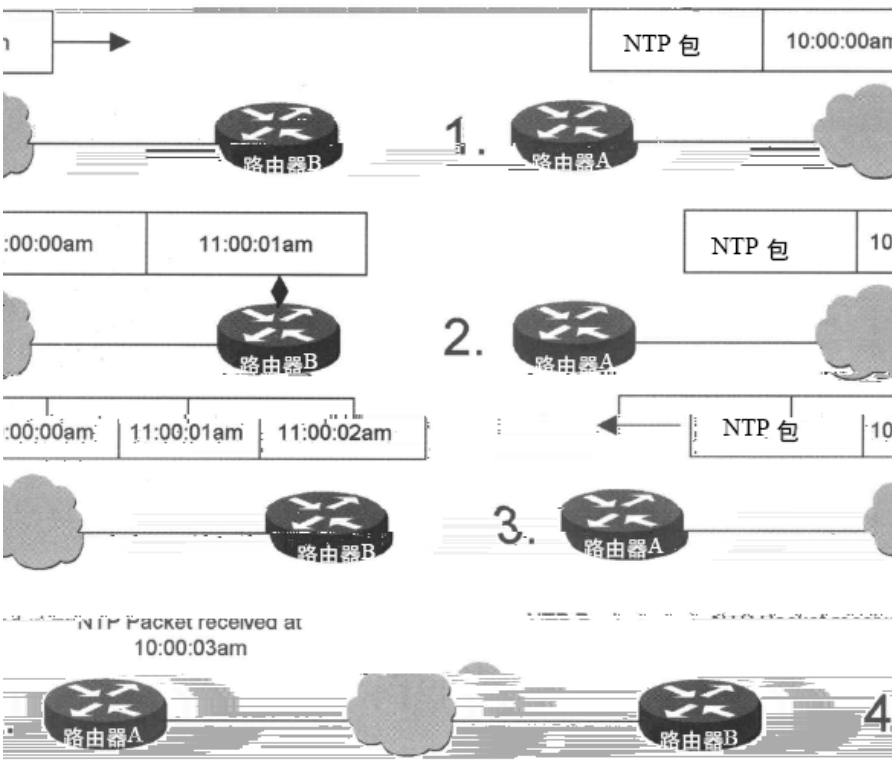
Hostname
root@RSR04E# set system host-name RSR04E-1

[edit]
root@RSR04E# commit
commit complete

[edit]
root@RSR04E-1#

RSR04/08E

[edit]
2 ssh Ł 2 ssh 1 2 a Â
root@RSR04E-1#



3 – 4

ل Ю'

1) A N T P B A й 10:00:00 a.m. Â

2) N T P B B╖ Э й 11 : 0 0 : 0 1 a . m . Â

3) N T P B B'Ą ╖ Э й 11:00:02 a.m. Â

4) A ╖ Э й 10:00:03 a.m. Â

A Л ' • NTP Â

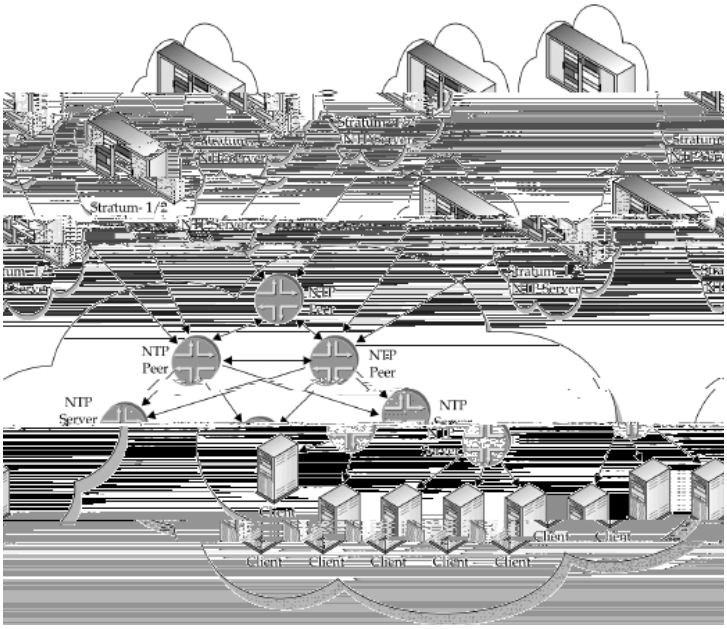
• A B Â

A б B ل Â

ل N T P R F C 1 3 0 5 N T P

ل Â

¸ NTP ^ JUNOS RFC 1305[8] version3˜



3 – 4

(1) JUNOS NTP

Configuring the NTP Boot Server

Specifying a Source Address for an NTP Server

Configuring the NTP Time Server and Time Services

Configuring NTP Authentication Keys

Configuring the Router to Listen for Broadcast Messages

Configuring the Router to Listen for Multicast Messages

(2) Syntax

[edit system]

Syntax

ntp {

Syntax:

server *address* <key *key-number*> <version *value*> <prefer>;

authentication-key *key-number* type *type* value *password*;

boot-server *address*;

trusted-key [*key-numbers*];

example :

[edit system ntp]

authentication-key 1 type md5 value *"9EgfcrvX7VY4ZEcwgoHjkP5Q3CuREyv87";*

boot-server *10.1.1.1*;

server *10.1.1.1* **key** 1 **prefer**;

trusted-key 1;

4 Symmetric Active

symmetric active router system

[edit system ntp]

peer *address* <key *key-number*> <version *value*> <prefer>

5 NTP server

router ntp server

Syntax:

[edit system ntp]

authentication-key *key-number* type *type* value *password*;

server *address* <key *key-number*> <version *value*> <prefer>;

trusted-key [*key-numbers*];

example

[edit system ntp]

authentication-key *1* **type** *md5* **value** "9txERuBEreWx-wtuLNdboaUjH.T3AtOESe";

server *172.17.17.27.46* **prefer**;

trusted-key *1*;

6 NTP

Lab@RSR> show ntp status

Lab@RSR>show ntp associations

ntp services

3.3.4 SNMP

JUNOS SNMP version 3

(1) SNMP Agent

Syntax

```
community community-name {
    authorization authorization;
    clients {
        address restrict;
    }
    view view-name;
}
```

Example:

admin@RSR04E-1# **set snmp community** *tester* **authorization read-only clients** *192.168.0.1/24*

admin@RSR04E-1# **set snmp community** *tester* **authorization read-only clients** 10.10.10.0/24 restrict

```
snmp {
    community tester {
        authorization read-only;
        clients {
            192.168.0.1/24;
            10.10.10.0/24 restrict    /**** a    10.10.10.0/24    y    router snmp ****/
        }
    }
```

(2) SNMP trap-group

Syntax

```
trap-group group-name {
    categories [ categories ];    /****    trap    ****/
    destination-port <port-number>;
    targets {
        address;                  /***    ****/
    }
    version (all | v1 | v2);      /****          *******/
}
```

Example:

```
Snmp{
    trap-group tester {
        categories {
```

```
        link;     /***        ў ╠ trap        ў     ***/
    }
```

Junos ⅃ ꓶ syslog consolê ⁄ ˜ - ╘ Â

¸ facilities and Severity levels

JUNOS system logging Facilities (logging ꞕ)

Facility **Type of Event or Error**

Syntax :

```
syslog {
    archive {
        files number;
        size size;
        (world-readable | no-world-readable);
    }
    console {
        facility severity;
    }
    file filerity;
        explicit-priority;
        match "regular-expression";
        archive {
            files number;
            size size;
            (world-readable | no-world-readable);
        }
    }
    host (hostname | other-routing-engine | scc-master) {
        facility severity;
        explicit-priority;
        facility-overrde facility;
        log-prefix string;
        match "regular-expression";
  ce-address;
    time-format (year | millisecond | year millisecond);
    user (username | *) {
        facility severity;
        match "regular-expression";
    }
}
```

Syslog Files

¸ log ¸
admin@RSR04E-1# edit system

[edit system]
admin@RSR04E-1# **set syslog file** messages *any notice*
¸ log
log 128k 10
admin@RSR04E-1# edit system

[edit system]
admin@RSR04E-1# s**et syslog archive** *size* 1m *files* 20
1M 20 Â

¸ syslog server udp 514 Â
[edit system]
admin@RSR04E-1# **set syslog host** 192.168.0.1 *any alert*
local*X* facility name
admin@RSR04E-1# **set syslog host 192.168.0.1 facility-override** *local0*

4 Traceoptions

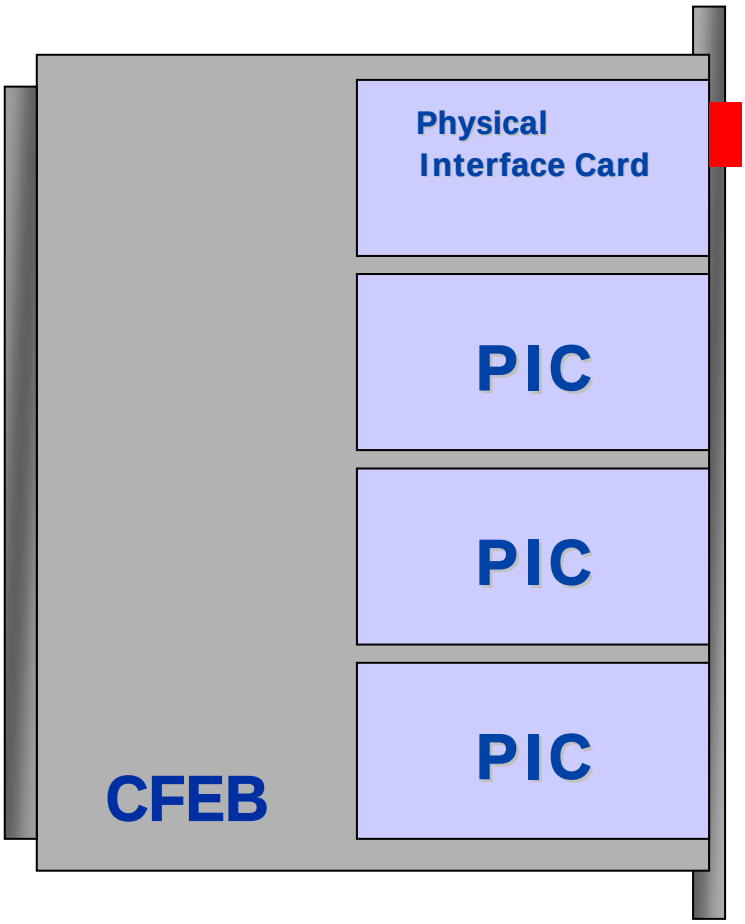
ÞO ÞÆ log
admin@RSR04E-1# **set traceoptions file** *interface.log* **size** *1m* **files** *10*
admin@RSR04E-1# **set traceoptions flag** *change-events*
example
interfaces {
traceoptions {
file interface.log size 1m files 10;
flag change-events;
}
)

admin@RSR04E-1>Show log

Log /var/log/

4 interface

¸ RSR04E à RSR08E ´ 1 CFEB ┘Л 4 PIC Â



4-1

4.1

╟ show interfaces terse Л Â

Interface type-CFEB # / PIC Slot ˛ Port #

¸ **Interface Media Type**

- Â **at—ATM over SONET/SDH ports**
- Â **e1—E1 ports**
- Â **e3—E3 ports**
- Â **fe—Fast Ethernet ports**

- **so—SONET/SDH ports**
- **t1—T1 ports**
- **t3—DS-3 ports**
- **ge—Gigabit Ethernet ports**
- **ae—Aggregated Ethernet ports**

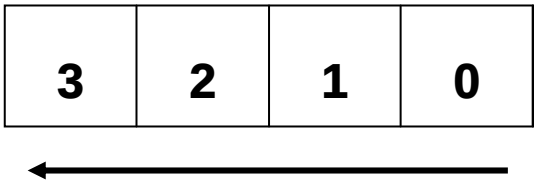
CFEB slot number

RSR 04E CFEB CFEB number 0
RSR 08E CFEB 0 1

	0
	1

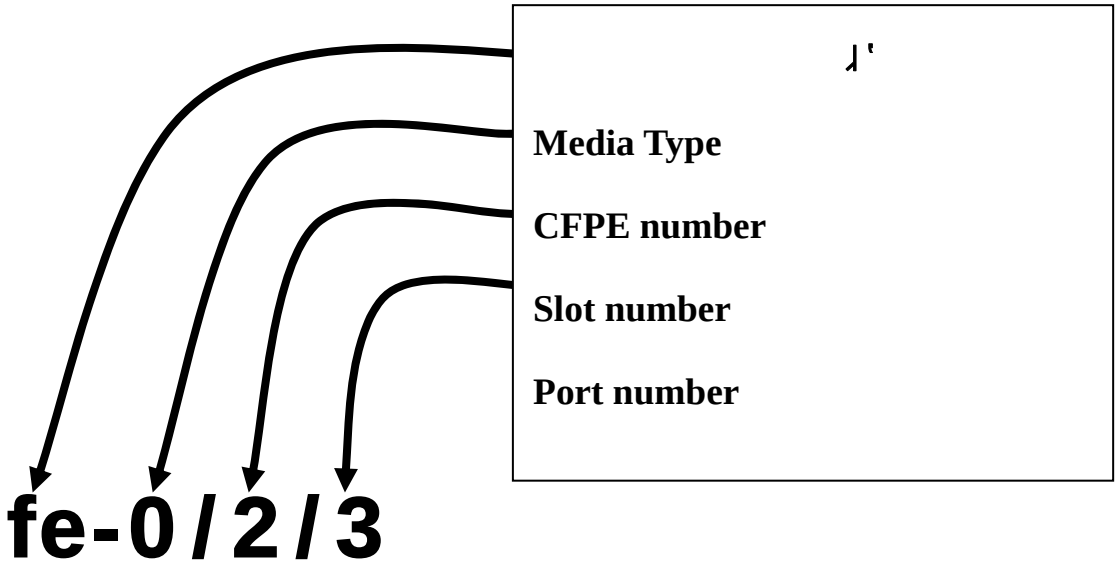
4-2

PIC slot number



4 -3

Interface name



4 -4

admin@RSR04E-1> configure
Entering configuration mode
admin@RSR04E-1# set interfaces fe-0/0/0 mtu 1514

[edit]
admin@RSR04E-1# commit
commit complete

[edit]

admin@RSR04E-1# set fe-0/0/0 unit 0 family inet address 192.168.11.1/24

unit number

1 **unit**

ATM vc frame- rely DLCI

2 **unit** **unit** **0**

3 **unit**

4.2 Ethernet interface : GE and FE

RSR GE FE VLAN tagging MTU

4.4.1 MAC

1024 **16** 16

Public count 1008
Private base address 00:12:1e:01:33:f0
Private count 16

4.4.2 VLAN Tagging

RSR 802.1Q VLAN tagging. Vlan IDs 0 4095

Example:

1, RSR04E б RG—6806E trunk 802.1Q FE trunk

(1) RSR config

```
interfaces {
    fe-0/0/0 {
        description to-RG6808-4/5;
        vlan-tagging;
        unit 11 {
            vlan-id 11;
            family inet {
                address 10.10.11.2/24;
            }
        }
        unit 12 {
            vlan-id 12;
            family inet {
                address 10.10.12.2/24;
            }
        }
    }
```

(2) RG-6806E

```
interface Giy7bitEthernet 4/5
 speed   100
 duplex full
 description "to-RSR04E-fe-0/0/0"
switchport mode trunk
```

2, RSR04E б RG—6806E trunk 802.1Q GE trunk

^ 1˜ RG-6806E

```
    interface Giy7bitEthernet 4/9
```

Ң ' RSR04/08E Ѐ Ң

```
 medium-type fiber
 speed    1000
 description "to-RSR04E-ge-1/3/0"
switchport mode trunk
```

(2) RSR04E

```
interfaces {
    ge-1/3/0 {
        description to-RG-6808E;
        vlan-tagging;
        unit 13 {
            vlan-id 13;
            family inet {
                address 10.10.13.2/24;
            }
        }
        unit 14 {
            vlan-id 14;
            family inet {
                address 10.10.14.2/24;
            }
        }
    }
```

4.2.3 Source Filtering

mac

```
interfaces {
    ge-1/3/0 {
        description to-RG-6808E;
        vlan-tagging;
        gigether-options {
            source-filtering;        /****                    *****/
            source-address-filter {
                00:90:69:6e:b8:01;    /*****        é          *****/

            }
        }
    }
}
```

4.3 VRRP RFC 2338

4.3.1

VRRP ' VRID ѝ 0—255 Â ѝ
MAC ѝ 00-00-5E-00-01-[VRID] Â ў ARP MAC
Â ⁋ IP MAC ⁋
Â
VRRP ѧ ' VRRP (advertisement) Â IP
ѝ 224.0.0.18 ѧ ѧ Â VRID a ѧ ѧЛ Â ѝ
ѧ ў ѧЛ VRRP Â Ь
a VRRP ѝ 0 Ѧ ╟ VRRP
VRRP ў VRRP 0—255 Â VRRP
IP IP ѧ ‡ VRRP IP
' IP ╟ έ ' 255 Â 0 IP ў ╟ ў
Â ѧ ѝ 1—254 Â ‡ ѧЛ à
ѧ Л è Â ў
VRRP IP ‡ ѝ ў Â ѧ
IP ÂVRRP ´
æ ў ѝ ў Â
ѝ VRRP ' IP Â
' ╗ VRRP ѧ ѧ VRID Â
a ÂIP
Â

4.3.2 RSR

Syntax:

```
vrrp-group group-number {
    (accept-data | no-accept-data);
    advertise-interval seconds;
    authentication-type authentication;
    authentication-key key;
    fast-interval milliseconds;
    (preempt | no-preempt) {
        hold-time seconds;
    }
    priority number;
    track {
        interface interface-name priority-cost cost;
```

ң ' RSR04/08E Ѧ ң

```
        }
        virtual-address [ addresses ];
    }
```

Exaple

Router A

```
fe-0/0/1 {
    unit 0 {
        family inet {
            address 10.10.11.2/24 {
                vrrp-group 10 {
                    virtual-address 10.10.11.1;
                    priority 105;
                    accept-data;
                }
            }
        }
    }
}
```

Router B

4 -6

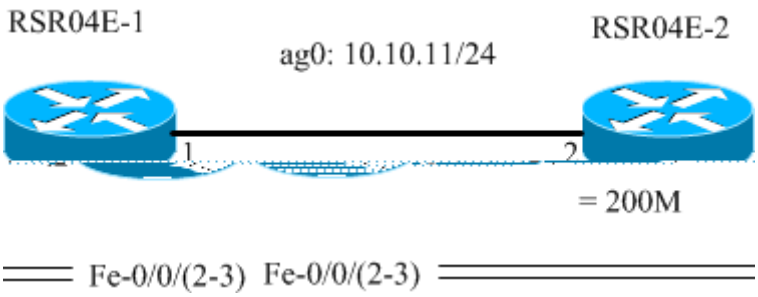
```
admin@RouterA # show vrrp detail
  Physical interface: fe-0/0/1, Unit: 0, Address: 10.10.11.2/24
    Index: 65, SNMP ifIndex: 31, VRRP-Traps: disabled
    Interface state: up, Group: 10, State: backup
    Priority: 105, Advertisement interval: 1, Authentication type: none
    Preempt: yes, Accept-data mode: yes, VIP count: 1, VIP: 10.10.11.1
    Dead timer: 2.921s, Master priority: 150, Master router: 10.10.11.3
    Virtual router uptime: 00:21:53
    Tracking: disabled
admin@RouterB>show vrrp detail
Physical interface: fe-0/0/1, Unit: 0, Address: 10.10.11.3/24
  Index: 65, SNMP ifIndex: 25, VRRP-Traps: disabled
  Interface state: up, Group: 10, State: master
  Priority: 150, Advertisement interval: 1, Authentication type: none
  Preempt: yes, Accept-data mode: no, VIP count: 1, VIP: 10.10.11.1
  Advertisement timer: 0.779s, Master router: 10.10.11.3
  Virtual router uptime: 00:20:41, Master router uptime: 00:20:37
  Virtual MAC: 00:00:5e:00:01:0a
  Tracking: disabled
```

accept-data vip ICMP

clear vrrp vrrp

4.4 Aggregated Interfaces

Junos Ethernet full-duplex mode with VLAN tagging Â Sonet
Â



4 -6

RSR04E-1

[edit]

admin@RSR04E-1> show

chassis {

```
 port-group 1
 speed    100
 duplex full
!
interface GigabitEthernet 4/2
 port-group 1
 speed    100
 duplex full
!
interface Vlan 100
 ip address 10.10.11.2 255.255.255.0
!
```

4.5 Troubleshooting interface

4.5.1 monitor interface

┘Л monitor interface <interface> ╟

┘Л monitor traffic interface

Example:

```
dmin@RSR04E-1> monitor traffic interface fe-0/0/1
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Listening on fe-0/0/1, capture size 96 bytes

08:32:23.253227    In IP 10.10.11.3 > 224.0.0.18: VRRPv2-advertisement 20: vrid=10 prio=150 authtype=simple intvl=1
08:32:24.583251    In IP 10.10.11.3 > 224.0.0.18: VRRPv2-advertisement 20: vrid=10 prio=150 authtype=simple intvl=1
08:32:26.073227    In IP 10.10.11.3 > 224.0.0.18: VRRPv2-advertisement 20: vrid=10 prio=150 authtype=simple intvl=1
^C
3 packets received by filter
0 packets dropped by kernel
```

4.5.1 show interfaces fe-0/0/0 extensive

Â

4.5.2 E-1 Loopback

```
admin@RSR# set loopback ?
possible completions:
  local                local loopback
  remote               remote loopback
```

5. protocol-Independent Routing

5.1

¸ ¶
¸ Ю
¸ Л routing-options

Syntax'

[edit]

```
routing-options {
    static {
        defaults {
            static-options;
        }
        route destination-prefix {
            next-hop next-hop;
            qualified-next-hop address {
                metric metric;
                preference preference;
            }
            static-options;
        }
    }
}
```

Example:

```
[edit]
user@host# show
routing-options {
    static {
        route 0.0.0.0/0 next-hop 192.168.0.1;
    }
}
```

¸ Discard à Reject
cisco Ю null 0 a ˩ Reject ICMP
Ï' Destination Host Unreachable Ł Â Discard ICMP

```
routing-options {
  static {
      route 143.172.0.0/6 discard;
  }
```

}

Syntax

```
[edit]
routing-options {
   generate {
      defaults {
         generate-options;
      }
      route destination-prefix {
         policy policy-name;
         generate-options;
      }
```

Example

```
routing-options {
     generate {
          defaults {
               metric 5;
          }
          route 172.16.64.0/20;
          route 172.16.80.0/20 discard;
          }
     }
```

5.3 Martian Routes

Assigned Numbers Authority (IANA).

http://www.iana.org/assignments/ipv4-address-space.

The default list of martian routes in the JUNOS software is:

```
Prefix bits of 0.0.0.0 /8 and more specific routes
Prefix bits of 127.0.0.0 /8 and more specific routes
Prefix bits of 128.0.0.0 /16 and more specific routes
Prefix bits of 191.255.0.0 /16 and more specific routes
Prefix bits of 192.0.0.0 /24 and more specific routes
Prefix bits of 223.255.255.0 /24 and more specific routes
Prefix bits of 240.0.0.0 /4 and more specific routes
```

Junos a Â Â

Syntax:

```
routing-options {
    martians {
        prefix/prefix-length match-type allow;
    }
}
```

Match-type exact à longer à orlonger à prefix-length-range à through à upto:

```
user@Riesling> show route martians

inet.0:
            0.0.0.0/0 exact -- allowed
            0.0.0.0/8 orlonger -- disallowed
            127.0.0.0/8 orlonger -- disallowed
            128.0.0.0/16 orlonger -- disallowed
            191.255.0.0/16 orlonger -- disallowed
            192.0.0.0/24 orlonger -- disallowed
            223.255.255.0/24 orlonger -- disallowed
            240.0.0.0/4 orlonger – disallowed
```

5.4 JUNOS

junos Â ЛЛ Â '

```
      inet.0     -  store IPv4 unicast routes
      inet.1     -  store IPv4 multicast routes
      inet.2     -  store IPv4 multicast routes   Routes in the inet.2 table
      are used by multicast routing protocols to prevent routing loops
      inet.3     -   The inet.3
```

5.5 JUNOS software Preference Values

JUNOS preference cisco Â

Source or Protocol Name	Meaning	Preference Value

5.6

```
[edit]
routing-options {
    rib fbf-north.inet.0 {
        static {
            route 0.0.0.0/0 next-hop 172.16.1.1;
        }
    }
    rib fbf-south.inet.0 {
        static {
            route 0.0.0.0/0 next-hop 172.16.2.1;
        }
    }
    static {
        route 0.0.0.0/0 next-hop 192.168.0.1;
    }
}
```

Rib-groups

inet.0 inet.2 ospf-rib ospf Â

Example:

```
routing-options {
  rib-groups {
        ospf-rib {
            import-rib [ inet.0 inet.2 ];
        }
    }
}
protocols {
    ospf {
        rib-group ospf-rib;
    }
}
```

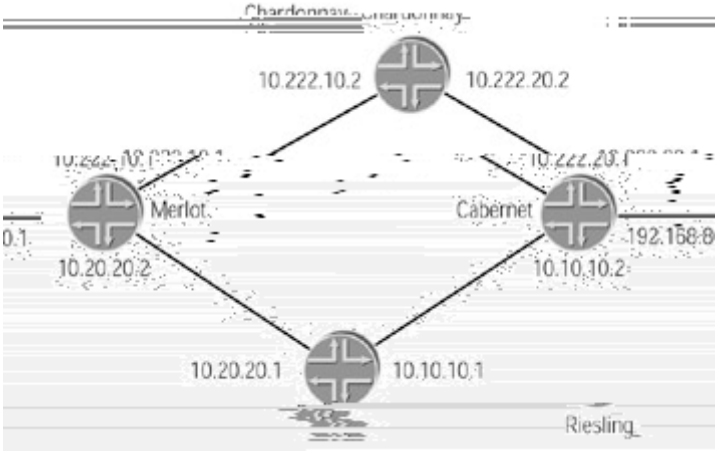
5.7 Load Balancing

JUNOS Load Balancing

Example:

```
routing-options {
    forwarding-table {
        export load-balance;
```

```
    }
}
 policy-options {
    policy-statement load-balance {
        then {
            load-balance per-packet;
            accept;
        }
    }
}
```



(1)

```
user@Merlot> show route 192.168.80/24 terse

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

A Destination        P Prf Metric 1   Metric 2    Next hop        AS path
* 192.168.80.1/32    I  18          20             10.222.10.2
                                                  >10.20.20.1
```

(2)

```
user@Merlot> show route forwarding-table matching 192.168.80/24

Routing table:: inet
Internet:
Destination        Type RtRef Nexthop         Type Index NhRef Netif
192.168.80.1/32    user     0 10.20.20.0      ucst    26     30so-0/0/3.0
^ 3~
[edit]
user@Riesling# show
policy-options {
    policy-statement please-load-balance-traffic {
        then {
            load-balance per-packet;
```

```
        }
    }
}
```

ɺ Ꮑ Ю '

Layer 3'

Incoming interface
Source IP address
Destination IP address

Protocol (TCP or UDP)
Source port number
Destination port number

ˆ 4˜

```
user@Merlot> show route forwarding-table matching 192.168.80/24

Routing table:: inet
Internet:
Destination        Type RtRef Nexthop      Type Index NhRef Netif
192.168.80.1/32    user     0              ulst    30    14
                               10.222.10.0  ucst    20    19 so-0/0/0.0
                               10.20.20.0   ucst    26    22 so-0/0/3.0
```

ˆ 5˜ Internet Processor ASICs and Load Balancing

Internet Processor ASIC forwards packets across 8 equal-cost next hops
Internet Processor ASIC forwards packets on a per-packet basis only.

Internet Processor II ASIC, however, is able to forward across 16 equal-cost next hops. Internet Processor II ASIC is based on a microflow.

5.8 Features

¸ Router-ID Lo0

```
[edit]
routing-options {
    router-id 172.168.1.1;
```

}

¸ Autonomous system number

BGP

[edit]

routing-options {

autonomous-system 65001;

}

6¨ Route policy

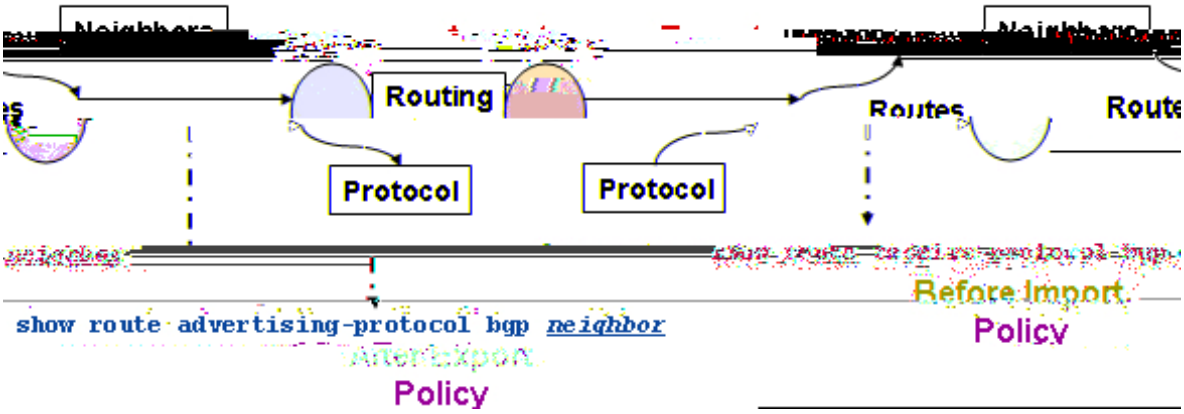
Â BGP Â

à Â

6.4

show route receive-protocol show route receive-protocol

Â



6 – 2

6.5

6.5.1

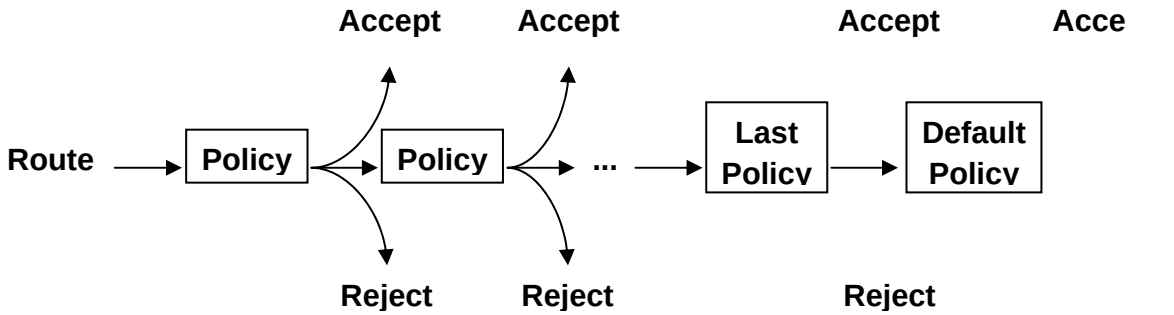
Syntax

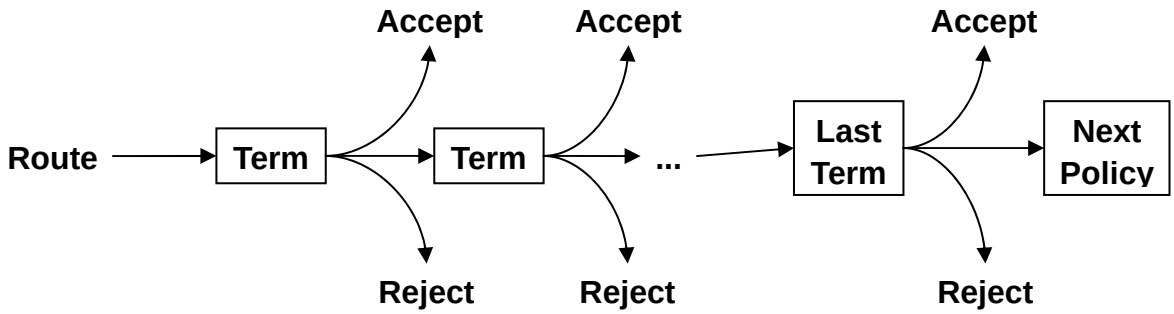
```
policy-options {
    policy-statement policy-name {
        term term-name {
            from {
                match-conditions;      /***  ***/
            }
            then {
                action;                /***  ***/
            }
        }
        term term-name {
            from {
                match-conditions;
            }
            then {
                action;
            }
        }
```

}

}

Routing Policy Flow '





6 -3

6.6

¸ ¬

¸ ¬ '

1. **Neighbor address**
2. **Protocol (source of information)**
   - **BGP, direct, DVMRP, IS-IS, local, MPLS, OSPF,**
   - **PIM, RIP, static, aggregate**
3. **Routing protocol information**
   - **OSPF area ID**
   - **IS-IS level number**
   - **BGP attributes**

¸ From and To

— From ¬ ' area area-id àas-path name àcommunity [names] àlevel level à local-preference value à metric metric à neighbor address à next-hop address à origin value à preference preference à protocol protocol à rib routing-table

to ┐ ' level *level* à rib *routing-table*'

Example:

```
policy-options {
    policy-statement isis-export {
        term sending-to-neighborA {
            to level 2;
            then accept;
        }
    }
}
```

6.7

- **Actions:**
  - **Terminate**
    - **Accept route**
    - **Reject (or suppress) route**
  - **Flow control**
    - **Skip to next policy**
    - **Skip to next term**
  - **Modify attributes**
    - **Metric**
    - **Preference**
    - **Color**
    - **Next-hop address**

6.8 default policy

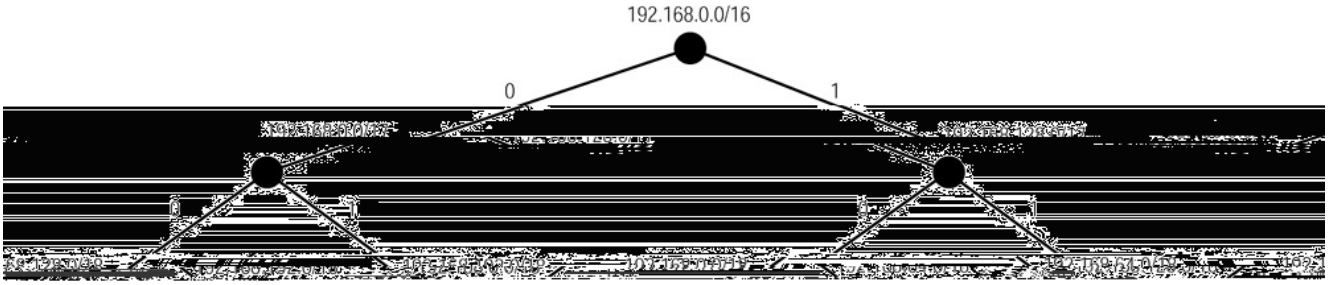
- ┐ ЮО Â
- IS—IS OSPF and RIP
  - **Import all routes**
  - **Export all routes learned by that protocol and all interface routes on which the protocol is configured explicitly (except RIP)**
- **BGP**
  - **Import all routes learned from BGP neighbors**
  - **Export all active routes learned from BGP neighbors to all BGP neighbors**
    - **EBGP-learned routes are exported to all BGP peers**
    - **IBGP-learned routes are exported to all EBGP peers (logical full-mesh)**

6.9 Route Filters

¸ **cisco ip prifex** ¬ Â

Syntax' route-filter *prefix/prefix-length match-type actions;*

HO '



6 - 4

— **Exact**

route-filter 192.168.0.0/16 exact;

— **orlonger;**

route-filter 192.168.0.0/16 orlonger;

— **longer**

route-filter 192.168.0.0/16 longer;

— **upto**

route-filter 192.168.0.0/16 upto /18;

— **prefix-length-range**

route-filter 192.168.0.0/16 prefix-length-range /17-/18;

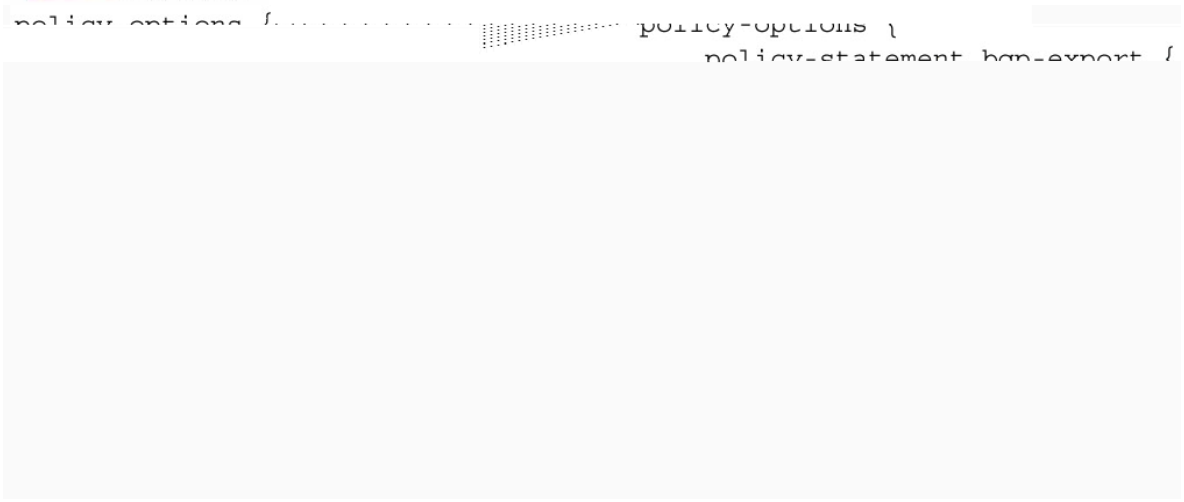
— **through**

route-filter 192.168.0.0/16 through 192.168.128.0/19;

6 - 5

6.10 Route Filters and Other Match Criteria

ר Route Filters Route Filter Л ר è Â
Ю '



Ò 6 – 6

6.11 Applying Routing Policies

z RIP Policy Application

```
SURWRFROV ^
    ULS ^
        LPSRUSVWRO>LIS\ROLF\ @
        JURXS WHVW ^
            H[SRUSVWRO>LIS\ROLF\ @
            QHLJKERU IH          ^
                LPSRUSVWRO>LIS\ROLF\ @
            `
        `
    `
`
```

z Link-State IGP Policy Application

```
SURWRFROV ^
    LVLV ^
        H[SRUSVWRO>LIS\ROLF\ @
    `
    RVSI ^
        H[SRUSVWRO>LIS\ROLF\  @
    `
`
```

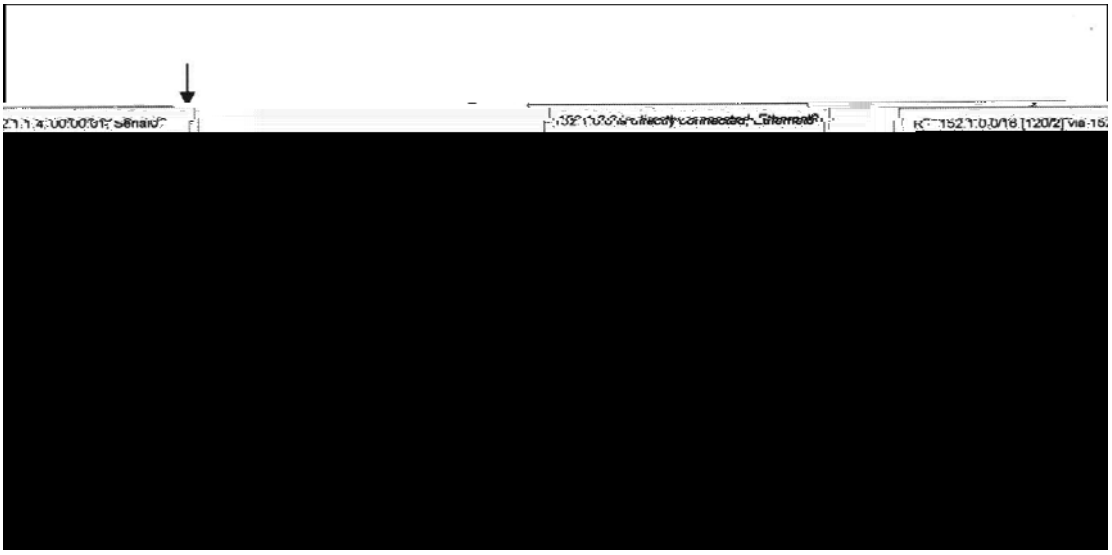
6.12 BGP Policy Application

```
[ ий Ь                  Â
protocols {
    bgp {
        import [ policy1 policy2 ...];
        export [ policy1 policy2 ...];
        group external-peers {
            type external;
            import [ policy1 policy2 ...];
            export [ policy1 policy2 ...];
            peer-as 65521;
            neighbor 1.1.1.1 {
                import [ policy1 policy2 ...];
                export [ policy1 policy2 ...];
            }
        }
    }
}
```

7 Routing Information Protocol (RIP)

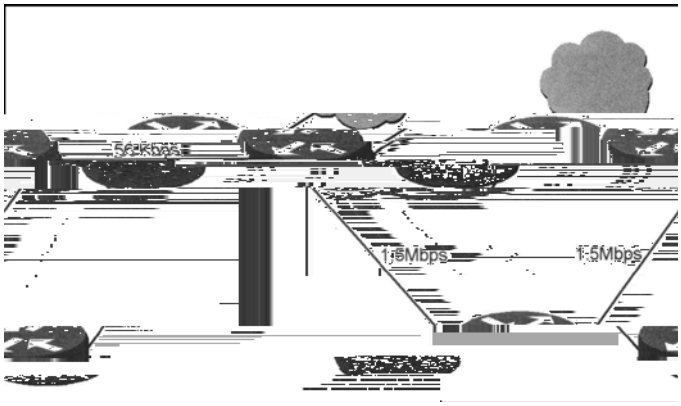
7.1 RIP

RIP (UNPDATES) (REQUESTS)
RIP 30 UDP 520
IP
RIP



7-1 RIP

RIP
1 8-1 C C
B 152.1.0.0 1
B A 152.1.0.0 1 2 8-1
a
8-2 A B RIP 56KBPS
a 1.5Mbps 1 56KBPS 2 1.5Mbps



7-2

7.2.1

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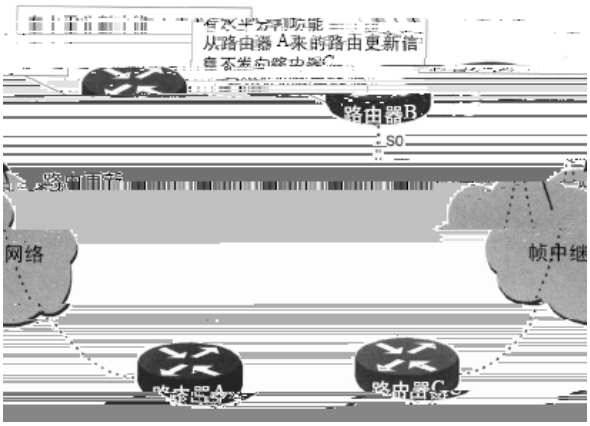

7-3

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3) C A Лυ 3 AÂ

4) A B Лυ 4 AÂ

5) й RIP Ιҗй 16Â
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7.2.2 RIP

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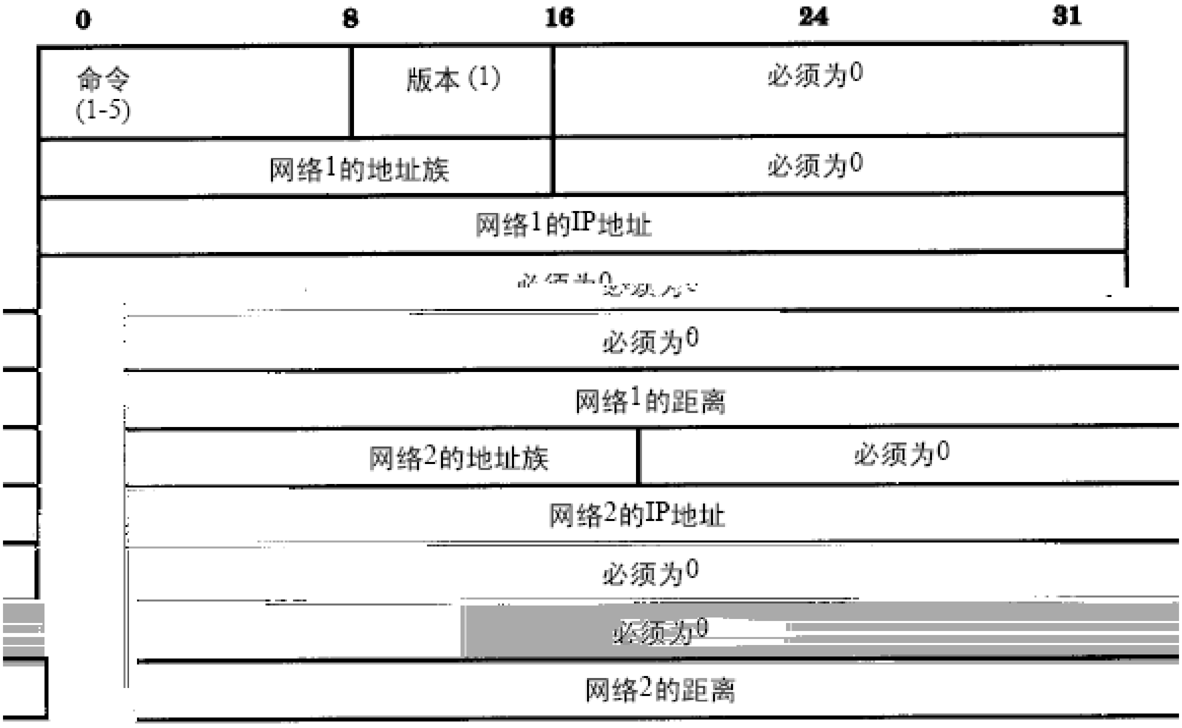
I P Â Commands (ɿ): Ю
ɿ ѫ R I P ˆ 1˜ ѫ R I P ˆ 2˜ Â ɿ 3 4 a
ɿ 5 Sun Microsystems Â Ve r s i o nˆ ˜ '
ꟿ Â R I P Â Address Family Identifierˆ ˜ '
R I P Â Â I P
2 Â IP Addressˆ I P ˜ ' I P I P ӥ 4 Â
Must Be Zeroˆ ˜ ' R I P 1 2 Â I P 1 2
4 Ю 8 Â Distance to Netˆ ˜ :
Â a ˩ ‡ ӥ 1 6 Â



7-5 RIP

˩ ⴈ RFC

RFC 1058, "Routing Information Protocol"
RFC 2082, "RIP-2 MD5 Authentication"
RFC 2453, "RIP Version 2"

7.3 RIP

— RIP '

[edit protocol]

```
protocols {
    rip {
        group group-name {
            neighbor interface-name;
        }
    }
}
```

— RIP Export

```
policy-options {
    policy-statement statics-to-rip {
        from protocol static;
        then accept;
    }
}
```

—

```
protocols {
    rip {
        group rip-neighbors {
            export statics-to-rip;
            neighbor fe-0/0/0.0;
            neighbor fe-0/0/1.0;
        }
    }
}
```

7.3 Monitoring RIP

7.3.1 RIP

```
user@Cabernet> show rip neighbor
                     Source          Destination     Send    Receive   In
Neighbor       State Address         Address         Mode    Mode      Met
---------      ----- -------         -----------     ----    ----      ---
```

```
fe-0/0/0.0      Up      172.16.1.2      224.0.0.9       mcast   both      1
fe-0/0/1.0      Up      172.16.2.1      224.0.0.9       mcast   both      1
```

7.3.2 RIP

```
user@Riesling> show route protocol rip

inet.0: 27 destinations, 27 routes (27 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.2.0/24       *[RIP/100] 00:07:25, metric 2
                     > to 172.16.1.2 via fe-0/0/0.0
192.168.8.1/32      *[RIP/100] 00:07:25, metric 2
                     > to 172.16.1.2 via fe-0/0/0.0
192.168.24.1/32     *[RIP/100] 00:00:25, metric 3
                     > to 172.16.1.2 via fe-0/0/0.0
```

7.3.3 RIP

lab@sf-pe> **show route advertising-protocol rip 10.0.21.1**

inet.0: 12 destinations, 12 routes (11 active, 1 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

3.0.0.0/8 *[Static/5] 00:10:56
Reject
30.0.0.0/16 *[Static/5] 00:12:20
Reject

7.3.4 RIP

lab@p1> **show route receive-protocol rip 10.100.3.2**

inet.0: 17 destinations, 18 routes (17 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.20.4.0/24 *[RIP/100] 00:01:01, metric 2
> to 10.100.3.2 via fe-0/0/0.0
192.168.28.0/24 *[RIP/100] 00:01:01, metric 2
> to 10.100.3.2 via so-0/0/0.0

7.3.5 RIP statistics

lab@sf-pe> **show rip statistics**

RIP info: port 520; update interval 30s; holddown 180s; timeout 120s.

rts learned	rts held down	rqsts dropped	resps dropped
1	1	0	0

fe-0/0/0.0: 1 routes learned; 3 routes advertised

Counter	Total	Last 5 min	Last minute
Updates Sent	28	11	2
Triggered Updates Sent	1	0	0
Responses Sent	0	0	0
Bad Messages	0	0	0
RIPv1 Updates Received	0	0	0
RIPv1 Bad Route Entries	0	0	0
RIPv1 Updates Ignored	0	0	0
RIPv2 Updates Received	14	11	3
RIPv2 Bad Route Entries	0	0	0
RIPv2 Updates Ignored	0	0	0
Authentication Failures	0	0	0
RIP Requests Received	0	0	0
RIP Requests Ignored	0	0	0

7.3.5 RIP log

— Log file-related configuration options

```
[edit protocols rip]
      traceoptions {
           file name <replace> <size size> <files number> <no-stamp>
          }
[edit protocols rip]
lab@p1# show traceoptions file ?
Possible completions:
  <[Enter]>            Execute this command
  files                Maximum number of trace files (2..1000)
  no-stamp             Don't timestamp trace file
  no-world-readable    Don't allow any user to read the log file
```

```
        neighbor fe-0/0/1.0;
        neighbor fe-0/0/0.0;
    }
}
```

admin**@RSR04E-1# run show rip neighbor**

Neighbor	State	Source Address	Destination Address	Send Mode	Receive Mode	In Met
ge-1/3/0.0	Up	192.168.100.5	224.0.0.9	mcast	both	1
fe-0/0/1.0	Up	192.168.100.1	224.0.0.9	mcast	both	1

admin**@RSR04E-2**> **show rip neighbor**

Neighbor	State	Source Address	Destination Address	Send Mode	Receive Mode	In Met
fe-0/0/0.0	Up	192.168.100.13	224.0.0.9	mcast	both	1
fe-0/0/1.0	Up	192.168.100.2	224.0.0.9	mcast	both	1

8.2 OSPF

Л ÿ OSPF OSPF
ш ┘
OSPF LSA ┘ ш LSA
б ÿ LSA
ш ш Â
Diskjtra ш
ÿ IP Â ┘
┘

8.2.4 Ш

OSPF Ш AS¦ 9-1 LSA ↙
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Â ◢ ◞ DR BDR ◞ D
R ᏁᏗ ◢ ӊ Â DR
DR ɿ Â ≠ ᏁᏗ
ÂDR Hello DR
Hello Â ѝ DRÂ IP
Э Æ IP Â ip ospf priority ɿ ◞ᏁᏗ
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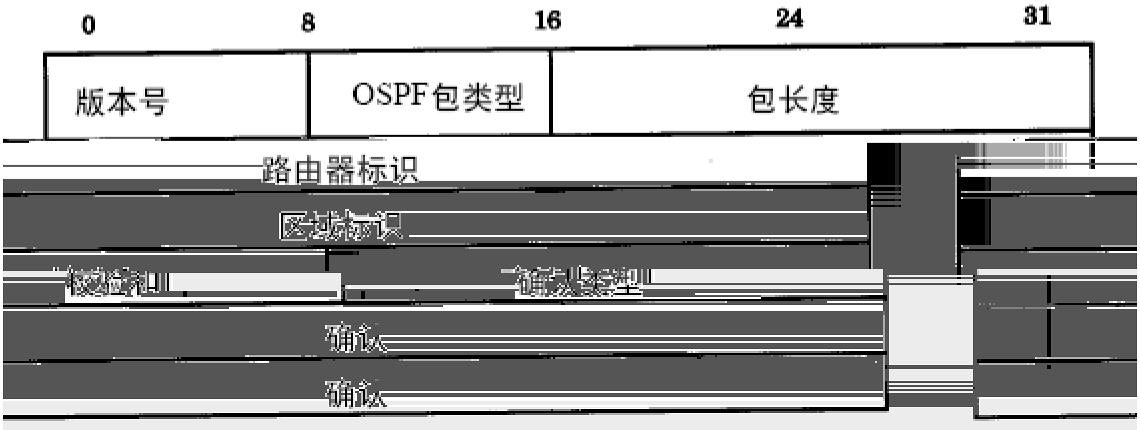
8.2.7 OSPF

OSPF IP89 Э ᏁᏗ 24 (8-2)Â



9-2 OSPF

5 OSPF (9-3)Â

类型	包名称	协议功能
[illegible]	[illegible]	发现并维持邻居
2	数据库描述	概括数据库容量
3	链路状态请求	请求数据库信息

9-3 OSPF

1) Hello ' Hello ÂHello
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Â

2) ' OSPF Ł

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Â

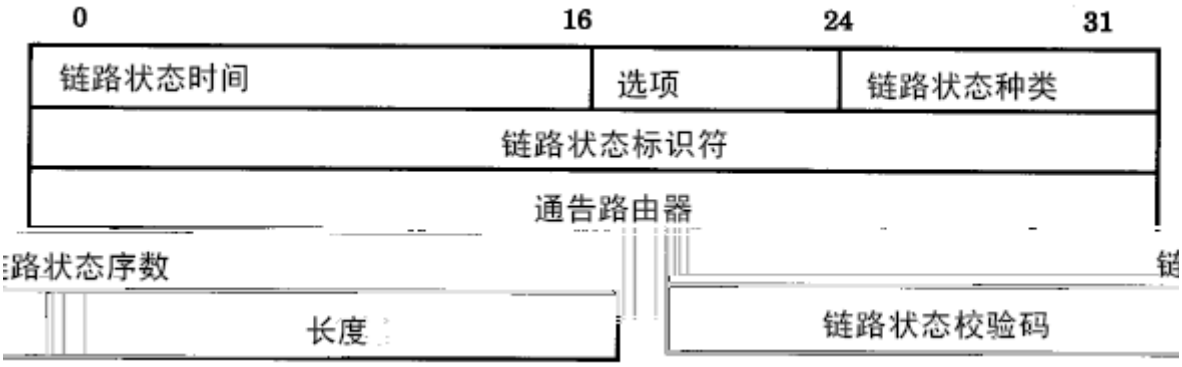
3) ' OSPF Ь
б Â ≠
† Â †
Â

4) ' OSPF
LSA LSA ˆ à à ˜Â

5) ' OSPF LSA
OSPF ┘ Â

8.2.8

8-1 a ┘ LSA
┘ 4 ў LSAÂ
Л┘ OSPF 20 ˆ 9-4˜



9-4

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ASBRӊ 5 LSA AS ÂAS 5
LSA AS Â
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a ܻ 1 ╗Э 2 1
ܶ й OSPF Â
5.
OSPF Hello 224.0.0.
5 OSPF Э ܶ Â
Ꮅ à ʅ Hello 10 NBMAЭ ATM
Hello 30 Â
Hello a ܻ Э
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DRÂ ܼ ܺ ˆ
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LSA
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й б Â
OSPF ᛧ Â RSR Э ܺᏂ show ospf neighbor ʅ
ÂЮ ʅ Â
B б 10.0.1.1 A ܻ Â

```
user@Chardonnay> show ospf neighbor
  Address          Interface           State      ID               Pri
Dead
10.0.1.46        at-0/1/0.100        Full       10.0.1.103       128    36
10.0.1.1         so-0/0/3.0          Full       10.0.1.23        128    39
```

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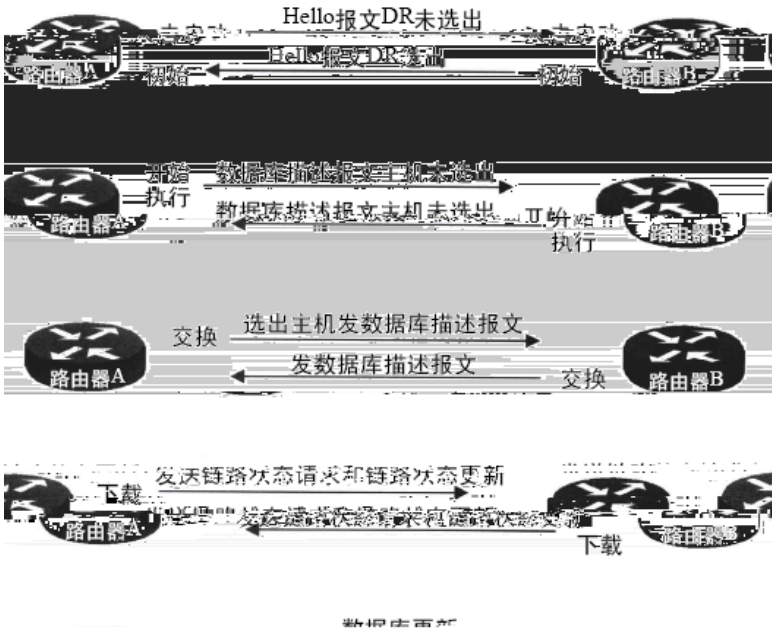

8-5

8.2.9 OSPF

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```
[edit]
user@host# show protocols ospf
ospf {
    area 0.0.0.0 {
        interface ge-0/0/0.0;
    }
}
```

8.3.2 OSPF ш

```
[edit]
user@host# show protocols ospf
ospf {
    area 0.0.0.0 {
        interface ge-0/0/0.0;
    }
}

[edit]
user@host# set protocols ospf area 1 interface at-0/1/1.100
[edit]
user@host# show protocols ospf
ospf {
    area 0.0.0.0 {
        interface ge-0/0/0.0;
    }
    area 0.0.0.1 {
        interface at-0/1/1.100;
    }
```

8.3.2 a Stub Area

[edit protocols ospf area *area-id*]
stub <default-metric *metric*> <(no-summaries | summaries)>;

8.3.3 a Not-So-Stubby Area

[edit protocols ospf area *area-id*]
nssa {

area-range *network/mask-length* <restrickm.
default-lsa {
default-metric *metric*.
metric-type *type*.
type-7.
}
(no-summaries | summaries);
}

8.4.4 OSPF Virtual Link

3 area virtual Link Â

[edit protocols ospf area 0.0.0.0]
virtual-link neighbor-id *router-id* transit-area *area-id*.

8.3.5 OSPF Router Interfaces

- **Configuring an Interface on a Broadcast or Point-to-Point Network**

[edit protocols ospf area *area-id*]
interface *interface-name*;

- **Configuring an Interface on a Point-to-Multipoint Network**

[edit protocols ospf area 0.0.0.0]
interface *interface-name* {
neighbor *address*.
}

- **Configuring an Interface on a Nonbroadcast, Multiaccess Network**

[edit protocols ospf area 0]
interface *interface-name* {
interface-type nbma;
neighbor *address* <eligible>;
poll-interval *seconds*.
}

8.3.6

simple MD5

[edit protocols ospf area *area-id*]

authentication-type *authentication*;

[edit protocols ospf area *area-id* interface *interface-name*]
authentication {
md5 *key-id* {
key [*key-values*];
}
simple-password *key-id*;
}

8.4 JUNOS Troubleshooting

8.4.1 б OSPF show ospf interface

```
user@Chardonnay> show ospf interface
Interface         State     Area            DR ID           BDR ID          Nbrs
at-0/1/0.100      PtToPt    0.0.0.0         0.0.0.0         0.0.0.0            1
so-0/0/1.0        PtToPt    0.0.0.0         0.0.0.0         0.0.0.0            1
so-0/0/0.0        PtToPt    0.0.0.10        0.0.0.0         0.0.0.0            1
so-0/0/2.0        PtToPt    0.0.0.10        0.0.0.0         0.0.0.0            1
so-0/0/3.0        PtToPt    0.0.0.10        0.0.0.0         0.0.0.0            1
```

Area — This field displays the current area ID assigned to the interface.

DR ID — The router ID of the current designated router is displayed in this column. Point-to-point interfaces use a value of 0.0.0.0.

BDR ID — The router ID of the current backup designated router is displayed in this column. Point-to-point interfaces use a value of 0.0.0.0.

Nbrs — The value in this column represents the total number of OSPF neighbors discovered across this interface.

8.4.2 OSPF

```
user@Chardonnay> show ospf neighbor
  Address          Interface          State     ID               Pri  Dead
10.0.1.46          at-0/1/0.100       Full      10.0.1.103       128    36
10.0.1.34          so-0/0/1.0         Full      10.0.1.102       128    35
10.0.1.9           so-0/0/0.0         Full      10.0.1.21        128    38
```

- Router-Type 1 router LSA
- Network-Type 2 network LSA
- Summary-Type 3 network summary LSA
- ASBRSum-Type 4 ASBR summary LSA
- Extern-Type 5 AS external LSA
- NSSA-Type 7 NSSA external LSA

ID This field shows the Link-State ID field from the LSA. This value is used to provide uniqueness for each LSA. Entries marked with an asterisk (*) are LSAs generated by the local router.

Adv Rtr The router ID of the originating router for each LSA is displayed in this field.

Seq The sequence number assists the router to determine the most recent version of the LSA.

Age This field displays the current age of the LSA. All LSAs begin with a lifetime of 0 and increment to a defined MaxAge of 3600 seconds. Each LSA must be refreshed before the MaxAge value is reached.

Opt The Options field from the OSPF header is displayed in this column. The possible bit values are discussed in the "Hello Packet" section earlier in this chapter.

Cksum The calculated checksum value of the LSA is stored in this field. Each router calculates a new checksum when the LSA is received and verifies the value against the received value to ensure packet integrity.

Len This field displays the total length of the LSA.

8.4.3 OSPF

clear ospf database

user@Shiraz> clear ospf database purge

OSPF floods Â

```
   Last instance of each event type
When            Type            Elapsed
00:17:29        SPF             0.000073
00:17:29        Stub            0.000067
00:17:29        Interarea       0.000025
00:17:29        External        0.000003
00:17:29        NSSA            0.000003
00:17:29        Cleanup         0.000083

   Maximum length of each event type
When            Type            Elapsed
01:17:57        SPF             0.000116
00:22:41        Stub            0.000365
20:00:18        Interarea       0.000132
01:19:43        External        0.000042
19:17:29        NSSA            0.000014
19:17:29        Cleanup         0.000715

   Last 100 events
When            Type            Elapsed
01:19:48          Total         0.000182
01:19:43        SPF             0.000090
01:19:43        Stub            0.000086
01:19:43        Interarea       0.000030
01:19:43        External        0.000042
01:19:43        NSSA            0.000004
...[output truncated]
```

8.4.6 OSPF statistics

```
user@Shiraz> show ospf statistics

Packet type              Total                    Last 5 seconds
                    Sent       Received       Sent       Received
   Hello              24             45          0              0
     DbD              24             16          0              0
   LSReq               6              7          0              0
LSUpdate             375           2260          0              0
   LSAck            2236            368          0              0
...
```

8.4.7 OSPF

show ospf route

```
user@Chardonnay> show ospf route
Prefix                 Path   Route       NH    Metric  NextHop
Nexthop
                       Type   Type        Type          Interface
addr/label
10.0.1.21/32           Intra  Router      IP    1        so-0/0/0.0
10.0.1.102/32          Intra  Router      IP    1        so-0/0/1.0
10.0.1.103/32          Intra  Router      IP    1        at-0/1/0.100
10.0.1.104/32          Intra  Router      IP    2        at-0/1/0.100
                                                       so-0/0/1.0
10.0.1.105/32          Intra  AS BR       IP    2        so-0/0/1.0
10.0.1.106/32          Intra  Router      IP    3        at-0/1/0.100
                                                       so-0/0/1.0
```

8.4.8 ospf

```
user@Chardonnay> show route protocol ospf

inet0000[illegible]
```

8.5 OSPF

' 192.168.101.x/30 Â lo0' 192.168.102.x/32 Â

8 - 6

'

RSR04E-1

```
interfaces {
    fe-0/0/0 {
        description to-RSR04E-2-fe-0/0/0;
        unit 0 {
            family inet {
                address 192.168.101.5/30;
            }
        }
    }
    fe-0/0/1 {
        description to-RG-R3600-eth0;
        unit 0 {
            family inet {
                address 192.168.101.9/30;
            }
```

Ң ' RSR04/08E Ā Ң

```
            }
        }
        fe-0/0/2 {
            description "to-RG-S3550-fa 0/25";
            unit 0 {
                family inet {
                    address 192.168.101.13/30;
                }
            }
        }
        ge-1/3/0 {
            description to-RG-S6806E-g4/9;
            unit 0 {
                family inet {
                    address 192.168.101.1/30;
                }
            }
        }
        lo0 {
            description RID;
            unit 0 {
                family inet {
                    address 192.168.102.1/32;
                }
            }
        }
}
routing-options {
        router-id 192.168.102.1;
}
protocols {
        ospf {
            area 0.0.0.0 {
                interface lo0.0 {
                    passive;
                }
                interface ge-1/3/0.0;
                interface fe-0/0/0.0;
            }
            area 0.0.0.1 {
                interface fe-0/0/1.0;
                interface fe-0/0/2.0;
            }
        }
```

```
}
```

RSR04E-2

```
interfaces {
    fe-0/0/0 {
        description to-RSR04E-1-fe-0/0/0;
        speed 100m;
        link-mode full-duplex;
        unit 0 {
            family inet {
                address 192.168.101.6/30;
            }
        }
    }
    fe-0/0/1 {
        description to-RG6806E-g4/1;
        unit 0 {
            family inet {
                address 192.168.101.17/30;
            }
        }
    }
    lo0 {
        description RID;
        unit 0 {
            family inet {
                address 192.168.102.2/32;
            }
        }
    }
}
routing-options {
    router-id 192.168.102.2;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface lo0.0 {
                passive;
            }
```

```
 no keepalive
 description to-RG-S3550-fa-0/25
!
interface Loopback 0
 ip address 192.168.102.3 255.255.255.255
 description RID
!
router ospf
 passive-interface Loopback 0
 network 192.168.101.8 0.0.0.3 area 0.0.0.1
 network 192.168.101.20 0.0.0.3 area 0.0.0.1
 network 192.168.102.3 0.0.0.0 area 0.0.0.1
!
```

RG-S3550'

```
interface FastEthernet 0/25
 no switchport
 description "to-RSR04E-1-fe-0/0/2"
 ip address 192.168.101.14 255.255.255.252
!
interface FastEthernet 0/26
 no switchport
 description "to-RG-R3600-fa0/1"
 ip address 192.168.101.21 255.255.255.252
!
interface Loopback 0
 description "RID"
 ip address 192.168.102.4 255.255.255.255
!
router ospf
area 0.0.0.1
network 192.168.101.12 255.255.255.252 area 0.0.0.1
network 192.168.101.20 255.255.255.252 area 0.0.0.1
network 192.168.102.4 255.255.255.255 area 0.0.0.1
!
End
```

8.5.1 RSR ospf

admin@RSR04E-1> **show route protocol ospf**

inet.0: 18 destinations, 18 routes (18 active, 0 holddown, 0 hidden)

RSR04/08E

+ = Active Route, - = Last Active, * = Both

192.168.101.16/30 *[OSPF/10] 00:35:03, metric 2
> to 192.168.101.6 via fe-0/0/0.0
to 192.168.101.2 via ge-1/3/0.0
192.168.101.20/30 *[OSPF/10] 00:27:05, metric 2
> to 192.168.101.10 via fe-0/0/1.0
to 192.168.101.14 via fe-0/0/2.0
192.168.102.2/32 *[OSPF/10] 00:35:03, metric 1
> to 192.168.101.6 via fe-0/0/0.0
192.168.102.3/32 *[OSPF/10] 00:27:05, metric 2
> to 192.168.101.10 via fe-0/0/1.0
192.168.102.4/32 *[OSPF/10] 00:46:39, metric 2
> to 192.168.101.14 via fe-0/0/2.0
192.168.102.5/32 *[OSPF/10] 00:46:50, metric 2
> to 192.168.101.2 via ge-1/3/0.0
224.0.0.5/32 *[OSPF/10] 01:13:33, metric 1
MultiRecv

8.5.2 OSPF

admin@RSR04E-1> **show ospf neighbor**

Address	Interface	State	ID	Pri	Dead
192.168.101.6	fe-0/0/0.0	Full	192.168.102.2	128	35
192.168.101.2	ge-1/3/0.0	Full	192.168.102.5	1	39
192.168.101.10	fe-0/0/1.0	Full	192.168.102.3	1	30
192.168.101.14	fe-0/0/2.0	Full	192.168.102.4	1	30

8.5.3 б ospf

admin@RSR04E-1> **show ospf interface**

Interface	State	Area	DR ID	BDR ID	Nbrs
fe-0/0/0.0	DR	0.0.0.0	192.168.102.1	192.168.102.2	1
ge-1/3/0.0	DR	0.0.0.0	192.168.102.1	192.168.102.5	1
lo0.0	DRother	0.0.0.0	0.0.0.0	0.0.0.0	0
fe-0/0/1.0	BDR	0.0.0.1	192.168.102.3	192.168.102.1	1
fe-0/0/2.0	BDR	0.0.0.1	192.168.102.4	192.168.102.1	1

8.5.4

admin@RSR04E-1> **show route protocol ospf | match /32**
192.168.102.2/32 *[OSPF/10] 00:55:06, metric 1
192.168.102.3/32 *[OSPF/10] 00:55:06, metric 2
192.168.102.4/32 *[OSPF/10] 00:55:06, metric 2
192.168.102.5/32 *[OSPF/10] 00:55:06, metric 2
224.0.0.5/32 *[OSPF/10] 02:31:34, metric 1

8.5.5

admin@RSR04E-1> **show route forwarding-table destination 192.168.101.16/30**
Routing table: inet
Internet:

Destination	Type	RtRef	Next hop	Type	Index	NhRef	Netif
192.168.101.16/30	user	0	192.168.101.6	ucst	341	3	fe-0/0/0.0

8.5.7 OSPF Authentication

¸ JUNOS MD5 Simple Â

Example:

' 8.5-1 Area 0 MD5 Â Area 1 Â

```
dmin@RSR04E-1# show
ospf {
    area 0.0.0.0 {
        authentication-type md5;
        interface lo0.0 {
            passive;
        }
        interface ge-1/3/0.0 {
            authentication {
                md5 10 key "$9$nj7z9tOhSeX7V1R7VwYZG69A"; ## SECRET-DATA
            }
        }
        interface fe-0/0/0.0 {
            authentication-type simple;
            authentication {
                md5 10 key "$9$tXIZ01hevLVwgSrwgoJHkp0B"; ## SECRET-DATA
            }
        }
    }
    area 0.0.0.1 {
        interface fe-0/0/1.0 {
            authentication {
                simple-password "$9$WlEXNb4aU.PQaZ6A"; ## SECRET-DATA
            }
        }
        interface fe-0/0/2.0 {
            authentication {
                simple-password "$9$ZSDHmz39O1h36lM"; ## SECRET-DATA
            }
        }
    }
}
```

RG-6806E#show run
Building configuration...
Current configuration : 1005 bytes

!
Ң ' RSR04/08E Ѐ Ң

```
version 1.0
install 4 12sfp/gt
ip routing algorithm CRC32_UPPER
!
hostname RG-6806E
enable secret level 1 5 $2lowNq&3h`@IOrJ4imLMp]KQknAxB^"
enable secret level 15 5 $2,1u_;C3&-8U0<D4'.tj9=GQ+/7R:>H
!
interface GigabitEthernet 4/1
 no switchport
 description "to-RSR04E-2-fe-0/0/1"
 ip address 192.168.101.18 255.255.255.252
ip ospf authentication message-digest
ip ospf message-digest-key 10 md5 juniper
!
interface GigabitEthernet 4/9
 medium-type fiber
 no switchport
 speed    1000
 description "to-RSR04E-ge-1/3/0"
 ip address 192.168.101.2 255.255.255.252
ip ospf authentication message-digest
ip ospf message-digest-key 10 md5 juniper
!
interface Loopback 0
 description "RID"
 ip address 192.168.105ft-.105ft-.255.25per
```

enable password 7 1316064b1f
!
interface FastEthernet 0/0
ip ospf authentication-key junos
ip address 192.168.101.10 255.255.255.252
duplex auto
1 T4eedauto

Listening on fe-0/0/1.0, capture size 96 bytes

07:12:19.423729 In (tos 0xc0, ttl 1, id 16641, offset 0, flags [none], proto: OSPF (89), length: 68) 192.168.101.10 > 224.0.0.5: OSPFv2, Hello (1), length: 48

Router-ID: 192.168.102.3, Area 0.0.0.1, **Authentication Type:** unknown (1)junos^@^@^@"

Options: [External]

Hello Timer: 10s, Dead Timer 40s, Mask: 255.255.255.252, Priority: 1

Designated Router 192.168.101.9, Backup Designated Router 192.168.101.10

Neighbor List:

192.168.102.1

07:12:20.892801 Out 0:12:1e:1:30:1 1:0:5e:0:0:5 ip 82: (tos 0xc0, ttl5(c01 Tc 00.000088i)251o52(51o53251o52(1

8 – 7

RSR04E-1 200.0.0.0/24 ospf ospf LSA 5 type 2

admin@RSR04E-1# set routing-options static route 200.0.0.0/24 reject
[edit]

```
policy-options {
    policy-statement static {
        term static {
            from {
                protocol static;
                route-filter 200.0.0.0/24 exact;
            }
            then {
                metric 111;
                external {
                    type 2;
                }
                accept;
            }
        }
        term deny-any {
            then reject;
```

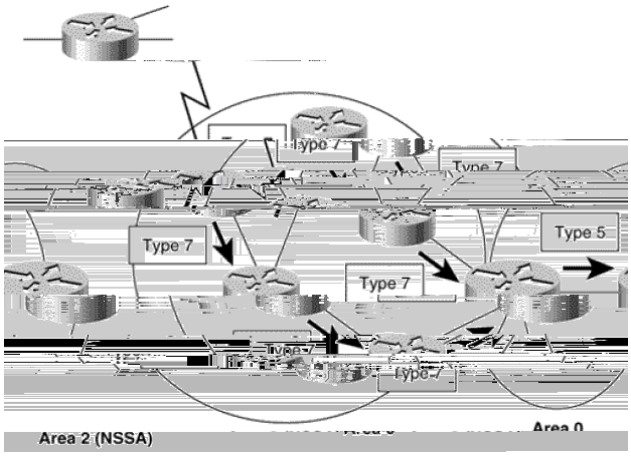
```
RG-R2600-2# show ip route
Codes: C - connected, S - static,    R - RIP
       O - OSPF, IA - OSPF inter area
       E1 - OSPF external type 1, E2 - OSPF external type 2

Gateway of last resort is 192.168.101.26 to network 0.0.0.0

    192.168.101.0/30 is subnetted, 10 subnets
```

8.7 Not-So-Stubby Areas (NSSA)

No type 5 or type 3 LSAs NSSA ABR Э ң LSA type 7 LSA 5
è area Â



8 – 8

NSSA ҳ

```
edit protocols ospf area 0.0.0.10]
admin@RSR04E-2#show
nssa {
  default-lsa {
    default-metric <value>;
    metric-type <value>;
    type-7;
  }
  no-summaries;
}
interface <interface-name>;

}
```

8.8 Virtual Links

Virtual Links — й backbone area ^ area 0˜ Â
Ю RSR04E-2 б RSR04E-1 RSR04E-2 lo0:
area 0 Â a Â Л Â 8.8-1 8.8-2

Syntax:

ң ' RSR04/08E Ä ң

```
            authentication-type md5;
            virtual-link neighbor-id 192.168.102.5 transit-area 0.0.0.10 {
                authentication {
                    md5 10 key "$9$FFE56CuRhr8X-O1X-VwaJ369"; ## SECRET-DATA
                }
            }
            interface lo0.0 {
                passive;
            }
            interface fe-0/0/0.0 {
                authentication {
                    md5 10 key "$9$oGZDk5Qnp0I.P0IEcvMaZU"; ## SECRET-DATA
                }
            }
        }
        area 0.0.0.10 {
            interface fe-0/0/2.0;
            interface fe-0/0/1.0;
        }
    }
}
```

RG-R6806E

```
admin@RSR04E-1# run telnet 192.168.102.5
Trying 192.168.102.5...
Connected to 192.168.102.5.
Escape character is '^]'.


User Access Verification

Password:
RG-6806E>en
Password:

RG-6806E#sho run
Building configuration...
Current configuration : 1501 bytes

!
version 1.0
install 4 12sfp/gt
ip routing algorithm CRC32_UPPER
!
hostname RG-6806E
```

enable secret level 1 5 $2-aeh`@31'dfimL4t{bcknAQ7zyglow

End

Э **backbone ^ AREA 0˜** **MD5 ╗** ⎍ Virtual Links ≠ MD5 ╗ Â

¸ Virtual Links

admin@RSR04E-2> **show ospf interface**

nterface	State	Area	DR ID	BDR ID	Nbrs
fe-0/0/0.0	DR	0.0.0.0	192.168.102.2	192.168.102.1	1
lo0.0	DRother	0.0.0.0	0.0.0.0	0.0.0.0	0
vl-192.168.102.5	**PtToPt**	**0.0.0.0**	**0.0.0.0**	**0.0.0.0**	**1**
fe-0/0/1.0	DR	0.0.0.10	192.168.102.2	192.168.102.5	1
fe-0/0/2.0	DR	0.0.0.10	192.168.102.2	192.168.102.6	1

admin@RSR04E-2> **show ospf neighbor**

Address	Interface	State	ID	Pri	Dead
192.168.101.5	fe-0/0/0.0	Full	192.168.102.1	128	38
192.168.101.18	**vl-192.168.102.5**	**Full**	**192.168.102.5**	**1**	**35**
192.168.101.18	fe-0/0/1.0	Full	192.168.102.5	1	36
192.168.101.37	fe-0/0/2.0	Full	192.168.102.6	1	36

¸ Disable Â

admin@RSR04E-2>**set interfaces fe-0/0/0.0 disable**

¸ **ospf**

admin@RSR04E-2> show ospf neighbor

Address	Interface	State	ID	Pri	Dead
192.168.101.18	**vl-192.168.102.5**	**Full**	**192.168.102.5**	**1**	**30**
192.168.101.18	fe-0/0/1.0	Full	192.168.102.5	1	30
192.168.101.37	fe-0/0/2.0	Full	192.168.102.6	1	31

9. Firewall Filters

Route policy Â firewall filters Â

9.1 firewall Filters Overview

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9.2

```
                match-conditions;
            }
            then {
                actions;
                action-modifiers;
            }
        }
        term term-name {
            from {
                match-conditions;
            }
            then {
                actions;
                action-modifiers;
            }
        }
    }
}
```

9.2.2 ╟

firewall filter ╟ diccard Â

```
term implicit-rule {
    then {
        discard;
    }
}
```

9.2.3 ┐

JUNOS ┐

telnet

```
 [edit firewall family inet]
user@Shiraz# show
filter port-number {
    term deny-telnet {
        from {
```

```
            protocol 6;
            port 23;
        }
        then {
            reject;
        }
    }
}
```

Well-known

```
[edit firewall family inet]
user@Shiraz# show
filter example-filter-1 {
    term deny-telnet {
        from {
            protocol tcp;
            port telnet;
        }
        then {
            reject;
        }
    }
}
```

```
[edit firewall family inet]
user@Shiraz# show
filter example-filter-2 {
    term allow-telnet {
        from {
            protocol tcp;
            port telnet;
        }
        then accept;
    }
    term allow-mail {
        from {
            protocol tcp;
            port smtp;
        }
```

```
        then accept;
    }
}
¸               ˥
[edit firewall family inet]
user@Shiraz# shp ӿ          Я   ᴰ f ® ᴰ ɮ   ᴰ ” ʎ   m˛ m̉    ᴰ f ® ᴰ ɮ̉
             }   thb@macl  î  a          a      ba
                ̉  ̉  ̉  ̉
             }   t        t ` @otoeolthc ` ;
             }   t        t ` ? @pf[thb  ö t]tcit ` }];
             }   t
             }       then accept;
                 }
```

Match Condition	Description
	also listed):The Expedited Forwarding RFC defines one codepoint: ef (46).The Assured Forwarding RFC defines 4 classes, with 3 drop precedences in each class, for a total of 12 codepoints: af11 (10), af12 (12), af13 (14), af21 (18), af22 (20), af23 (22), af31 (26), af32 (28), af33 (30), af41 (34), af42 (36), or af43 (38).
fragment-offset *number*	The fragment offset field.
icmp-code *number*	The ICMP code field. This value or keyword provides more specific information than the icmp-type condition. Because the value's meaning depends on the associated icmp-type, it must also be specified along with the icmp-code.
icmp-type *number*	The ICMP packet type field. Normally, you specify this match in conjunction with the protocol match condition to determine which protocol is being used on the port.In place of the numeric

```
        }
        then {
            reject;
        }
    }
}
```

Match Condition	Description
address *prefix*	The IP source or destination address field. You cannot specify both the address and the destination-address or source-address match conditions in the same term.
destination-address *prefix*	The IP destination address field. You cannot specify the destination-address and address match conditions in the same term.
destination-prefix-list *prefix-list*	The IP destination prefix list field. You cannot specify the destination-prefix-list and prefix-list match conditions in the same term.
prefix-list *prefix-list*	The IP source or destination prefix list field. You cannot specify both the prefix-list and the destination-prefix-list or source-prefix-list match conditions in the same term.
source-address *prefix*	The IP source address field. You cannot specify the source-address and address match conditions in the same rule.
source-prefix-list *prefix-list*	The IP source prefix list field. You cannot specify the source-prefix-list and prefix-list match conditions in the same term.

9.2.4 ╟

┐ ⅄ ╟ Ь ' terminating, flow-control, and action modifiers

9.2.4.1 terminating Actions

accept, discard, and reject Â Ь Â Discard reject a ⅄ reject ICMP Â

ң ' RSR04/08E Ä ң

9.2.4.2 Flow-Control Actions

Flow-Control Actions next term ╟ Â

Ю '
ˆ 1˜ Â ɰ log Â

```
[edit firewall family inet]
user@Shiraz# show
filter example-filter-9{
    term log-all-packets {
        then log;
    }
    term deny-telnet {
        from {
            protocol tcp;
            port telnet;
        }
        then {
            reject;
        }
    term accept-everything-else {
        then accept;
    }
}
```

ˆ 2˜ log ʎ Ю term Â

```
edit firewall family inet]
user@Shiraz# show
filter example-filter-9{
    term log-all-packets {
        then {
            log;
            next term;
    }
    term deny-telnet {
        from {
            protocol tcp;
            port telnet;
        }
        then {
            reject;
        }
    term accept-everything-else {
        then accept;
```

```
    }
}
```

9.2.4.2 Action Modifiers

count ' 10.0.0/24 Â

```
[edit firewall family inet]
user@Shiraz# show
filter inbound-from-peer {
    term count-traffic {
        from {
            source-address {
                10.0.0/24;
            }
        then {
            count traffic-counter;
            accept;
        }
    }
}
```

Log' memory-resident buffer that is 500 lines Â show firewall log Â

```
[edit firewall family inet]
user@Shiraz# show
filter log-tcp-flow-start {
    term count-syn {
        from {
            protocol tcp;
            tcp-initial;
        }
        then {
            log;
            accept;
        }
    }
}
```

Sample' ↓ Â

```
[edit firewall family inet]
user@Shiraz# show
filter sample-peer-traffic {
    term peer-connections {
        from {
            source-address {
                10.10.0.0/16;
                172.30.45.0/24;
```

```
                192.168.164.0/20;
            }
        }
        then {
            sample;
            accept;
        }
    }
}
```

Syslog

log

```
[edit firewall family inet]
user@Shiraz# show
filter log-tcp-flow-start {
    term count-syn {
        from {
            protocol tcp;
            tcp-initial;
        }
        then {
            syslog;
            accept;
        }
    }

}
```

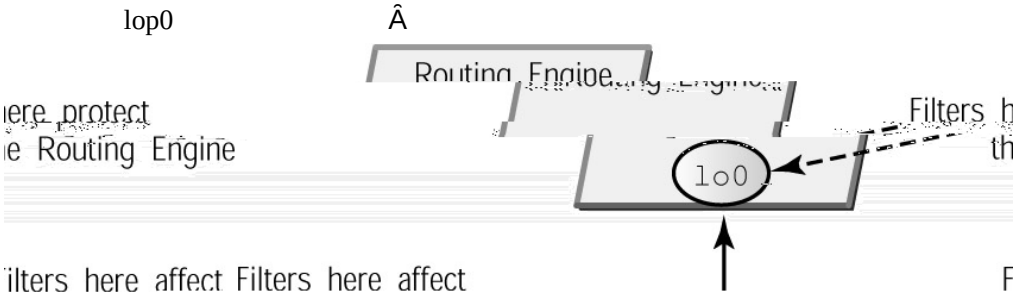
9.2.3 Applying Firewall Filters

firewall filters to interface

```
[edit interfaces fe-0/0/0]
user@Shiraz# show
description "Connection to AS 65000";
unit 0 {
    family inet {
        filter {
            input AS65000-inbound-filter;
            output AS65000-outbound-filter;
        }
        address 10.10.10.1/24;
    }
```

}

9.3 Protecting the Routing Engine



9-1

```
edit interfaces lo0]
user@Shiraz# show
unit 0 {
    family inet {
        filter {
            input protect-routing-engine;
        }
        address 192.168.1.1/32;
    }
}
```

9.4 Rate Limits

bandwidth-limit burst-size-limit,

```
    policer policer-1 {
        if-exceeding {
            bandwidth-limit 400k;   /**              **/
            burst-size-limit 100k; /**             丬      **/
        }
        then discard;    /***              500k 丬      ***/
    }
    term ftp {
        from {
            source-address {
                10.2.3/24;
            }
            protocol tcp;
            destination-port [ftp ftp-data];
        }
        then {
            policer policer-1;  /***      FTP **/
            accept;
        }
    }
    term accept-all {
        then accept;
    }
}
```

interface

```
[edit firewall]
user@Shiraz# show
policer police-all-traffic {
    if-exceeding {
        bandwidth-limit 10m;
        burst-size-limit 100k;
    }
    then {
        discard;
    }
}
[edit interfaces fe-0/0/0]
user@Shiraz# show
description "Connection to Customer-A";
unit 0 {
    family inet {
        policer {
            input police-all-traffic;
```

23 (2 packets)

9.5.3 show interfaces filters

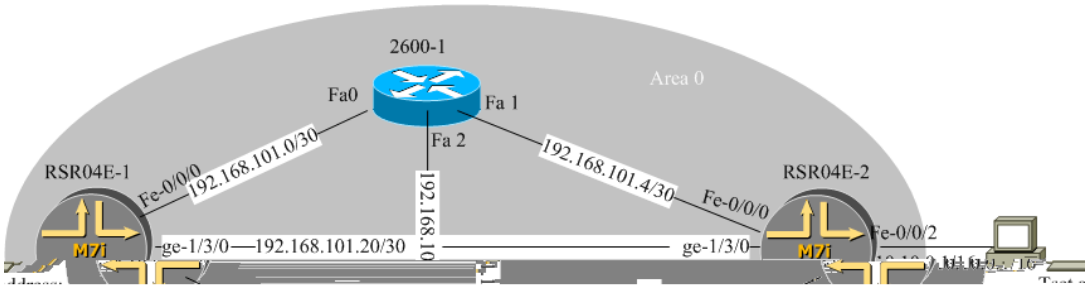
```
user@Shiraz> show interfaces filters
Interface       Admin Link Proto Input Filter         Output Filter
fe-0/0/0        up    up
fe-0/0/0.0      up    up   inet  filter-1
   filter-2
fe-0/0/1        up    up
fe-0/0/1.0      up    up   inet  filter-3
   filter-4
fe-0/0/2        up    down
fe-0/0/3        up    down

user@Shiraz> show interfaces policers
Interface       Admin Link Proto Input Policer         Output Policer
fe-0/0/0        up    up
fe-0/0/0.0      up    up   inet  fe-0/0/0.0-in-policer
   fe-0/0/0.0-out-policer
fe-0/0/1        up    up
fe-0/0/1.0      up    up   inet  fe-0/0/1.0-in-policer
   fe-0/0/1.0-out-policer

fe-0/0/2        up    down
fe-0/0/3        up    down
user@Shiraz> show policer
Policer: so-2/2/0.0-in-policer
    so-2/2/0.0-in-policer
                    0 packets
Policer: so-2/2/0.0-out-policer
    so-2/2/0.0-out-policer
                    238 packets
```

9.6 Configuring Filter-Based Forwarding

Â Ю Â



9 – 2

Ю'

RSR04E-2

1 10.10.0.2 RSR04E-1 lookback
193.1.1.1 RSR04E-2 2600-2 192.168.101.9
2 10.10.0.3 RSR04E-1 lookback
193.1.1.1 RSR04E-2 2600-1 192.168.101.5
3 è ╟ Â ≠ RSR04E-1 ge-1/3/0
192.168.101.20 Â

╖ RSR04 Ю '

1 routing-instances

```
routing-instances {
    route-source-filter1 {      /***  ⅃     ***/
        instance-type forwarding;     /***          ***/
        routing-options {
            static {
                route 0.0.0.0/0 next-hop 192.168.101.9;
            }
        }
    }
    route-source-filter2 {            /***  ⅃     ***/
        instance-type forwarding;    /***      и      ***/
        routing-options {
            static {
                route 0.0.0.0/0 next-hop 192.168.101.5;
            }
        }
    }
}

routing-options {
```

```
    interface-routes {
        rib-group inet source-filter;
    }
    rib-groups {
        source-filter {
            import-rib [ route-source-filter1.inet.0
            route-source-filter2.inet.0 inet.0 ];
        }
    }
 }
2, HX      '
firewall {
    family inet {
        filter classify-source {
            term isp1 {
                from {
                    source-address {
                        10.10.0.2/32;
                    }
                }
                then routing-instance route-source-filter1;
            }
            term isp2 {
                from {
                    source-address {
                        10.10.0.3/32;
                    }
                }
                then routing-instance route-source-filter2;
            }
            term default {
                then accept;
            }
        }
    }
}
4         é      '
interfaces {
    fe-0/0/2 {
        unit 0 {
            description to-3550-fa0/48;
            family inet {
                filter {
                    input classify-source;
```

```
                }
                address 10.10.0.1/16;
            }
        }
    }
}
5       traceroute      '

5.1 Л       10.10.0.2  traceroute      '
RG-S3550#traceroute 193.1.1.1
    1    12ms    1ms    1ms    10.10.0.1
    2    1ms    4ms    1ms    192.168.101.9
    3    1ms    2ms    1ms    193.1.1.1
Trace complete successfully.

5.2 Л       10.10.0.3  traceroute      '
RG-S3550#traceroute 193.1.1.1
    1    29ms    1ms    1ms    10.10.0.1
    2    1ms    1ms    1ms    192.168.101.5
    3    2ms    1ms    4ms    193.1.1.1
Trace complete successfully.

5.3 Л       10.10.0.3  traceroute      '
RG-S3550#traceroute 193.1.1.1
    1    3ms    1ms    1ms    10.10.0.1
    2    1ms    1ms    3ms    193.1.1.1
Trace complete successfully.




RSR04E-2        '
admin@RSR04E-2# show
version 7.3B1.1;
system {
    host-name RSR04E-2;
    root-authentication {
        encrypted-password "$1$4lSSr3rQ$dwkAWDsD6HZnsgdH7l.Zv1"; ##
SECRET-DATA
    }
    login {
        user admin {
            uid 2004;
            class super-user;
```

```
    }
    ge-1/3/0 {
        description to-RSR04E-1-ge-1/3/0;
        unit 0 {
            family inet {
                address 192.168.101.22/30;
            }
        }
    }
    fxp0 {
        description IMG;
        unit 0 {
            family inet {
                address 192.168.0.12/24;
            }
        }
    }
    lo0 {
        description RID;
        unit 0 {
            family inet {
                address 192.168.102.2/32;
            }
        }
    }
}
routing-options {
    interface-routes {
        rib-group inet source-filter;
    }
    rib-groups {
        source-filter {
            import-rib [ route-source-filter1.inet.0
route-source-filter2.inet.0 inet.0 ];
        }
    }
    router-id 192.168.102.2;
}
protocols {
    ospf {
        area 0.0.0.0 {
            interface fe-0/0/0.0;
            interface fe-0/0/1.0;
            interface lo0.0 {
```

```
                passive;
            }
            interface fe-0/0/2.0 {
                passive;
            }
            interface ge-1/3/0.0;
        }
    }
}
firewall {
    family inet {
        filter classify-source {
            term isp1 {
                from {
                    source-address {
                        10.10.0.2/32;
                    }
                }
                then routing-instance route-source-filter1;
            }
            term isp2 {
                from {
                    source-address {
                        10.10.0.3/32;
                    }
                }
                then routing-instance route-source-filter2;
            }
            term default {
                then accept;
            }
        }
    }
}
routing-instances {
    route-source-filter1 {
        instance-type forwarding;
        routing-options {
            static {
                route 0.0.0.0/0 next-hop 192.168.101.9;
            }
        }
    }
    route-source-filter2 {
```