Distance vector Routing protocols
Router configuration

- Select routing protocols
- Specify networks or interfaces
Dynamic Routing Configuration

Router(config)#router protocol [keyword]

• Defines an IP routing protocol

Router(config-router)#network network-number

• Mandatory configuration command for each IP routing process
• Identifies the physically connected network that routing updates are forwarded to
RIP Overview

- Maximum six paths (default = 4)
- Hop count metric selects the path
- Routes update every 30 seconds
RIP Configuration

Router(config)#router rip

• Starts the RIP routing process

Router(config-router)#network network-number

• Selects participating attached networks
• The network number must be a major classful network number
RIP Configuration Example

**RIP Configuration Example**

```
router rip
network 172.16.0.0
network 10.0.0.0
```

```
router rip
network 192.168.1.0
network 10.0.0.0
```

```
router rip
network 10.0.0.0
```

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Verifying the Routing Protocol—RIP

RouterA#sh ip protocols
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 0 seconds
Invalid after 180 seconds, hold down 180, flushed after 240
Outgoing update filter list for all interfaces is
Incoming update filter list for all interfaces is
Redistributing: rip
Default version control: send version 1, receive any version

<table>
<thead>
<tr>
<th>Interface</th>
<th>Send</th>
<th>Recv</th>
<th>Key-chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Serial2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Routing for Networks:
- 10.0.0.0
- 172.16.0.0

Routing Information Sources:
- Gateway  Distance  Last Update
  - 10.1.1.2   120   00:00:10

Distance: (default is 120)
Displaying the IP Routing Table

RouterA#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
    D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
    E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
    i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
    U - per-user static route, o - ODR
    T - traffic engineered route

Gateway of last resort is not set

    172.16.0.0/24 is subnetted, 1 subnets
    C    172.16.1.0 is directly connected, Ethernet0
    10.0.0.0/24 is subnetted, 2 subnets
       R    10.2.2.0 [120/1] via 10.1.1.2, 00:00:07, Serial2
       C    10.1.1.0 is directly connected, Serial2
       R    192.168.1.0/24 [120/2] via 10.1.1.2, 00:00:07, Serial2
RouterA#debug ip rip
RIP protocol debugging is on

RouterA#
00:06:24: RIP: received v1 update from 10.1.1.2 on Serial2
00:06:24: 10.2.2.0 in 1 hops
00:06:24: 192.168.1.0 in 2 hops
00:06:33: RIP: sending v1 update to 255.255.255.255 via Ethernet0 (172.16.1.1)
00:06:34: network 10.0.0.0, metric 1
00:06:34: network 192.168.1.0, metric 3
00:06:34: RIP: sending v1 update to 255.255.255.255 via Serial2 (10.1.1.1)
00:06:34: network 172.16.0.0, metric 1
Introduction to IGRP

- More scalable than RIP
- Sophisticated metric
- Multiple-path support
IGRP Composite Metric

- Bandwidth
- Delay
- Reliability
- Loading
- MTU
IGRP Unequal Multiple Paths

- Maximum six paths (default = 4)
- Within metric variance
- Next-hop router closer to destination
Configuring IGRP

Router(config)#router igrp autonomous-system
  • Defines IGRP as the IP routing protocol

Router(config-router)#network network-number
  • Selects participating attached networks
Configuring IGRP (cont.)

Router(config-router)#variance multiplier

- Control IGRP load balancing

Router(config-router)#traffic-share
{ balanced | min }

- Control how load-balanced traffic is distributed
IGRP Configuration Example

Autonomous System = 100

- router igrp 100
- network 172.16.0.0
- network 10.0.0.0

- router igrp 100
- network 192.168.1.0
- network 10.0.0.0

- router igrp 100
- network 10.0.0.0
Verifying the Routing Protocol—IGRP

RouterA#sh ip protocols
Routing Protocol is "igrp 100"
Sending updates every 90 seconds, next due in 21 seconds
Invalid after 270 seconds, hold down 280, flushed after 630
Outgoing update filter list for all interfaces is
Incoming update filter list for all interfaces is
Default networks flagged in outgoing updates
Default networks accepted from incoming updates
IGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
IGRP maximum hopcount 100
IGRP maximum metric variance 1
Redistributing: igrp 100
Routing for Networks:
10.0.0.0
172.16.0.0
Routing Information Sources:
Gateway         Distance      Last Update
10.1.1.2             100      00:01:01
Distance: (default is 100)
Displaying the IP Routing Table

RouterA#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
    D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
    E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
    i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
    U - per-user static route, o - ODR
    T - traffic engineered route

Gateway of last resort is not set

    172.16.0.0/24 is subnetted, 1 subnets
    C       172.16.1.0 is directly connected, Ethernet0
    10.0.0.0/24 is subnetted, 2 subnets
I       10.2.2.0 [100/90956] via 10.1.1.2, 00:00:23, Serial2
C       10.1.1.0 is directly connected, Serial2
I       192.168.1.0/24 [100/91056] via 10.1.1.2, 00:00:23, Serial2
debug ip igrp transaction
Command

RouterA#debug ip igrp transactions
IGRP protocol debugging is on
RouterA#
00:21:06: IGRP: sending update to 255.255.255.255 via Ethernet0 (172.16.1.1)
00:21:06: network 10.0.0.0, metric=88956
00:21:06: network 192.168.1.0, metric=91056
00:21:07: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.1)
00:21:07: network 172.16.0.0, metric=1100
00:21:16: IGRP: received update from 10.1.1.2 on Serial2
00:21:16: subnet 10.2.2.0, metric 90956 (neighbor 88956)
00:21:16: network 192.168.1.0, metric 91056 (neighbor 89056)
**debug ip igrp events**

**Command**

```
RouterA#debug ip igrp events
IGRP event debugging is on
RouterA#
00:23:44: IGRP: sending update to 255.255.255.255 via Ethernet0 (172.16.1.1)
00:23:44: IGRP: Update contains 0 interior, 2 system, and 0 exterior routes.
00:23:44: IGRP: Total routes in update: 2
00:23:44: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.1)
00:23:45: IGRP: Update contains 0 interior, 1 system, and 0 exterior routes.
00:23:45: IGRP: Total routes in update: 1
00:23:48: IGRP: received update from 10.1.1.2 on Serial2
00:23:48: IGRP: Update contains 1 interior, 1 system, and 0 exterior routes.
00:23:48: IGRP: Total routes in update: 2
```
RouterA# debug ip igrp trans
00:31:15: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0, changed state to down
00:31:15: IGRP: edition is now 3
00:31:15: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.1)
00:31:15: network 172.16.0.0, metric=4294967295
00:31:16: IGRP: Update contains 0 interior, 1 system, and 0 exterior routes.
00:31:16: IGRP: Total routes in update: 1
00:31:16: IGRP: broadcasting request on Serial2
00:31:16: IGRP: received update from 10.1.1.2 on Serial2
00:31:16: subnet 10.2.2.0, metric 90956 (neighbor 88956)
00:31:16: network 172.16.0.0, metric 4294967295 (inaccessible)
00:31:16: network 192.168.1.0, metric 91056 (neighbor 89056)
00:31:16: IGRP: Update contains 1 interior, 2 system, and 0 exterior routes.
00:31:16: IGRP: Total routes in update: 3
Updating Routing Information
Example (cont.)

RouterB#debug ip igrp trans
IGRP protocol debugging is on
RouterB#
1d19h: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.2)
1d19h: subnet 10.2.2.0, metric=88956
1d19h: network 192.168.1.0, metric=89056
1d19h: IGRP: sending update to 255.255.255.255 via Serial3 (10.2.2.2)
1d19h: subnet 10.1.1.0, metric=88956
1d19h: network 172.16.0.0, metric=89056
1d19h: IGRP: received update from 10.1.1.1 on Serial2
1d19h: network 172.16.0.0, metric 4294967295 (inaccessible)
1d19h: IGRP: edition is now 10
1d19h: IGRP: sending update to 255.255.255.255 via Serial2 (10.1.1.2)
1d19h: subnet 10.2.2.0, metric=88956
1d19h: network 192.168.1.0, metric=4294967295
1d19h: network 192.168.1.0, metric=89056
1d19h: IGRP: sending update to 255.255.255.255 via Serial3 (10.2.2.2)
1d19h: subnet 10.1.1.0, metric=88956
1d19h: network 172.16.0.0, metric=4294967295
Updating Routing Information

Example (cont.)

RouterB#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
U - per-user static route, o - ODR
T - traffic engineered route

Gateway of last resort is not set

I   172.16.0.0/16 is possibly down, routing via 10.1.1.1, Serial2
    10.0.0.0/24 is subnetted, 2 subnets
C   10.1.1.0 is directly connected, Serial2
C   10.2.2.0 is directly connected, Serial3
I   192.168.1.0/24 [100/89056] via 10.2.2.3, 00:00:14, Serial3
RouterB#ping 172.16.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.1, timeout is 2 seconds:
    ....
Success rate is 0 percent (0/5)
RouterB#
Updating Routing Information
Example (cont.)

RouterB#debug ip igrp transactions
RouterB#
1d20h: IGRP: received update from 10.1.1.1 on Serial2
1d20h: network 172.16.0.0, metric 89056 (neighbor 1100)
RouterB#
RouterB#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
    D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
    E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
    i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
    U - per-user static route, o - ODR
    T - traffic engineered route
Gateway of last resort is not set

I  172.16.0.0/16 is possibly down, routing via 10.1.1.1, Serial2
10.0.0.0/24 is subnetted, 2 subnets
C  10.1.1.0 is directly connected, Serial2
C  10.2.2.0 is directly connected, Serial3
I  192.168.1.0/24 [100/89056] via 10.2.2.3, 00:00:18, Serial3
RouterB#ping 172.16.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/38/48 ms
**ip classless Command**

Router(config)#ip classless

To get to 10.7.1.1:

- With `ip classless` → Default
- With `no ip classless` → Drop

<table>
<thead>
<tr>
<th>Network Protocol</th>
<th>Destination Network</th>
<th>Exit Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>10.1.0.0</td>
<td>E0</td>
</tr>
<tr>
<td>C</td>
<td>10.2.0.0</td>
<td>S0</td>
</tr>
<tr>
<td>RIP</td>
<td>172.16.0.0 via 0.0.0.0</td>
<td>S0</td>
</tr>
</tbody>
</table>