



## **RIPng Protocol**

**Teldat Dm814-I**

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# I Related Documents

Teldat Dm805-I IPv6 Addressing

# Chapter 1 Introduction

## 1.1 RIPng Protocol: Introduction

### 1.1.1 RIPng Protocol

This document describes the use of RIPng (Routing Information Protocol next generation), an Interior Gateway Protocol (IGP) developed for IPv6. A description of RIPng can be found in RFC 2080.

RIPng is a routing protocol based on the distance vector algorithm, also known as the Bellman-Ford algorithm. It is designed to allow routers to exchange information to compute routes in IPv6-enabled networks. Destinations may be networks or special values, which represent default routes. RIPng does not alter IPv6 datagrams but routes them based on the destination address field only. The distance vector algorithm causes routers to periodically broadcast their routing tables to all neighboring routers. Consequently, the router can decide where to send each packet because it knows the routing tables of all its neighbors.

Routers, using the same routing protocol, form an autonomous system (AS). This common routing protocol is known as an Interior Gateway Protocol. IGPs dynamically detect network accessibility and routing information in the autonomous system and use said information to make up the IPv6 routing table. RIPng was designed to operate as an IGP in moderate-sized autonomous systems; it is not suitable for large, complex environments.

### 1.1.2 Message Format

RIPng sends and receives datagrams on UDP port number 521. The RIPng packet format is shown in Figure 2:

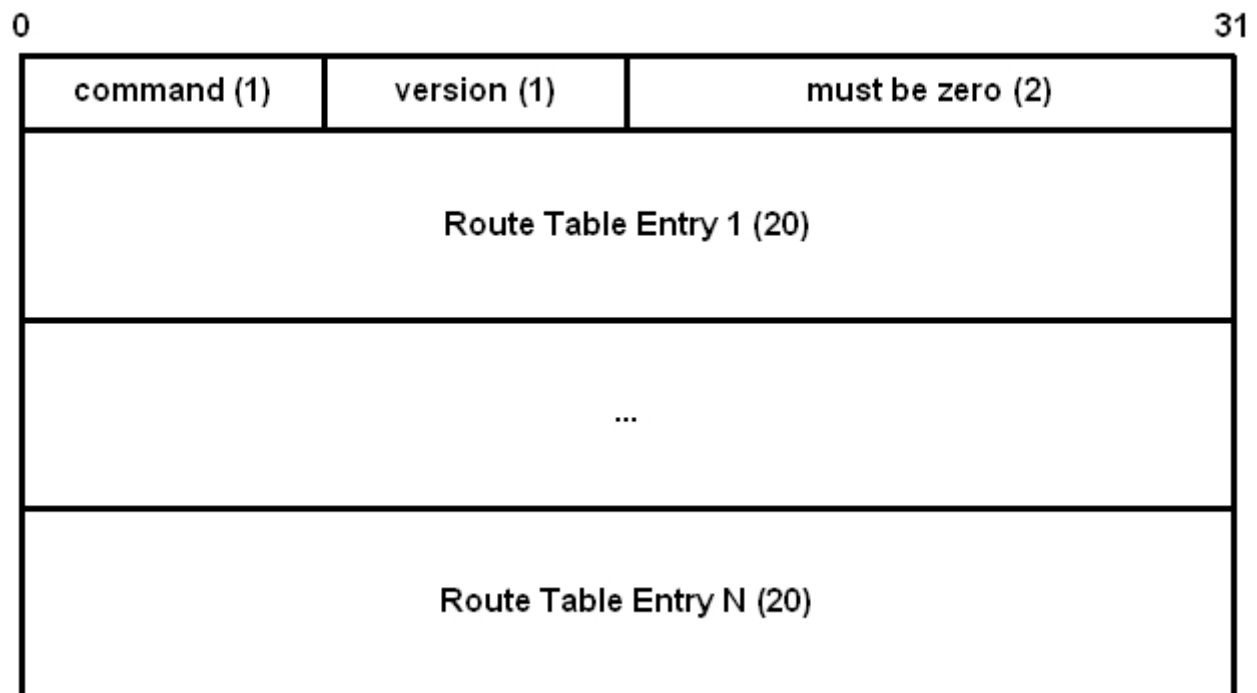


Fig. 1: RIPng message format

Each RTE (*Route Table Entry*) field (in the above figure) is explained in Figure 2.

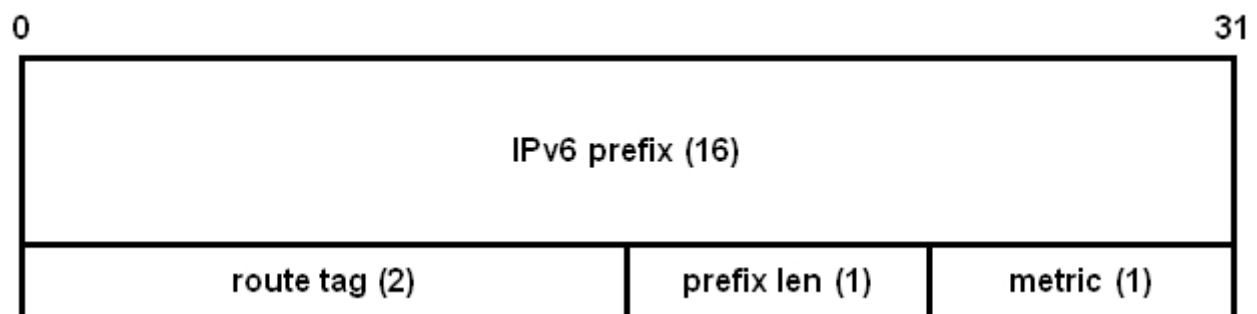


Fig. 2: RTE field format

The **command** field in the RIPng header can be one of two types:

**Request.** The router requests neighboring routers to send their routing tables. This message is usually sent when a router joins a network or when one of its interfaces activates.

**Response.** The router sends a message containing all or part of its routing table. This message can be sent in response to a *Request*, through periodic updates the router executes or an immediate update due to a change in said routing table.

Each RTE present in RIPng messages contains a prefix and associated cost to reach it (*metric*). This cost can be a value between 1 and 15 for reachable routes and 16 for unreachable routes.

RIPng provides the ability to indicate a next-hop IPv6 address for packets whose destination matches one of the routes defined in an RTE entry. Said entry appears after a special RTE **next hop**. The **next hop** is specified using a special RTE which applies to all RTE fields (that indicate IPv6 routes) until the end of the message or until another next-hop RTE is encountered. A **next hop** RTE is indicated by 255 in the metric field. In this case, the prefix field indicates the IPv6 address for the **next hop**.

### 1.1.3 RIPng Protocol Operation

- (1) When a router enables RIPng on one of its interfaces, thus joining an autonomous system of routers, it sends a **Request** message with multicast address FE02 :: 9 (all routers) telling the other routers to send it their routing tables.
- (2) The neighboring routers receiving the **Request** message send a **Response** message to the unicast address of the router that sent the **Request**. This message contains the complete routing table of the responding router. After receiving the routing tables, the router that sent the request combines this information to form its own routing table.
- (3) All routers periodically send their routing tables to all FE02::9 routers using **Response** messages.
- (4) Any changes to a router's routing table are immediately communicated to all routers through a **Response** message.
- (5) When a route becomes unreachable (metric 16) during a time defined in the standard, this is included in the **Response** messages to report its unreachability.

## Chapter 2 Configuration

### 2.1 RIPng Configuration Commands

This section summarizes and explains all the router configuration commands to configure RIPng routing protocol.

To access the RIPng configuration menu, enter the following commands:

```
*config
Config>protocol ripng
-- RIPng protocol user configuration --
RIPng config>
```

Command	Function
? (HELP)	Lists the commands or their options.
DEFAULT-INFORMATION	Announces the default route.
DISTANCE	Administrative distance.
NO	Allows you to establish the default value.
REDISTRIBUTE	Redistributes route information.
ROUTE	Announces RIPng routes.
TIMERS	Times associated with the RIPng protocol.
VRF	Configures RIPng in a VPN Routing/Forwarding instance.
EXIT	Exits the RIPng protocol configuration menu.

#### 2.1.1 ? (HELP)

Use “?” (HELP) to list the valid commands at the level where the router is programmed. You can also use it after a specific command to list the available options:

*Syntax:*

```
RIPng config>?
```

*Example:*

```
RIPng config>?
  default-information   Advertise the default route
  distance              Administrative distance
  no                   Negate a command or set its defaults
  redistribute         Redistribute information from another routing protocol
  route                Set static RIPng route announcement
  timers               Adjust RIPng timers
  exit
RIPng config>
```

#### 2.1.2 default-information

The **default-information** command allows the default IPv6 route (:: / 0) to be included in the RIPng messages announced by the router. This allows neighboring routers to incorporate the device announcing the default route.

*Syntax:*

```
RIPng config>default-information ?
  <cr>
RIPng config>
```

*Example:*

```
RIPng config>default-information
RIPng config>
```

## 2.1.3 distance

The **distance** command sets the administrative distance for RIPng-learned routes. Said distance is used to determine the preference of RIPng-learned IPv6 routes over other types of routes (static, OSPF6, BGP ...). Administrative distance should be a value between 1 and 254. Default is 100.

The following table shows the default administrative distances for different IPv6 routing protocols:

Type of route	Administrative Distance
Direct Routes	0
Internal OSPF Routes (intra/inter)	10
Static Routes	60
RIPng Routes	100
External OSPFv3 Routes	150
BGP Routes	170

*Syntax:*

```
RIPng config>distance ?
<1..254>  Value in the specified range
RIPng config>
```

*Example:*

```
RIPng config>distance 150
RIPng config>
```

This example establishes an administrative distance of 150 for RIPng.

## 2.1.4 no

The **no** command is used to set default values or delete any configuration changes you make.

*Syntax:*

```
RIPng config>no ?
default-information  Advertise the default route
default-metric      Set a metric of redistribute routes
distance            Administrative distance
redistribute        Redistribute information from another routing protocol
route              Set static RIPng route announcement
timers             Adjust RIPng timers
RIPng config>
```

*Example:*

```
IPv6 config>no timers
IPv6 config>
```

This example establishes default times associated with RIPng.

## 2.1.5 redistribute

The **redistribute** command is used to redistribute routes from one routing domain to another. To disable redistribution, enter **no** in front of the command.

*Syntax:*

```
RIPng config>redistribute ?
bgp          BGP routes
connected    Connected routes
ospfv3       OSPFv3 routes
static       Static routes
RIPng config>redistribute <protocol> ?
metric      Metric for redistributed routes
```



```

route-map    Route map reference
<cr>
RIPng config>redistribute <protocol> metric ?
<1..16>    Value in the specified range
RIPng config> redistribute <protocol> route-map ?
<word>    Route map name
RIPng config>

```

First, select the source protocol for routes to be redistributed. These routes can be **static**, directly **connected**, BGP routes or routes coming from the OSPFv3 protocol.

The type of selected route can be redistributed in three different ways:

- The CR (carriage return), default option, redistributes all routes selected with a metric of 1.
- If a metric is indicated, with a **metric** option, then all routes selected with the introduced metric are redistributed. Said metric must be a value between 1 and 16 (unreachable).
- If a route map is indicated, through **route-map**, then the routes selected according to the route map criteria are redistributed. The route map must be pre-created.

*Example:*

```
RIPng config>redistribute static metric 7
```

In this example, static route redistribution has been enabled with a metric of 7.

## 2.1.6 route

The **route** command allows you to include an IPv6 route in the RIPng messages announced by the router.

*Syntax:*

```

RIPng config>route ?
<a::b/l>    Ipv6 prefix
RIPng config>

```

*Example:*

```

RIPng config>route 2001:db8::/64
RIPng config>

```

This example includes route 2001:db8::/64 in RIPng messages sent by the router.

## 2.1.7 timers

The **timers** command allows you to define the three timers associated with RIPng, as described in RFC 2080. Only in exceptional cases is it necessary to change their values; the administrator should be absolutely sure before making any changes, and understand the possible consequences.

*Syntax:*

```

RIPng config>timers ?
<10..65535> Routing table update timer value in second (default 30 sec)
RIPng config>timers <update-time> ?
<10..65535> Routing information timeout timer (default 180 sec)
RIPng config>timers <update-time> <timeout-timer> ?
<10..65535> Garbage collection timer (default 120 sec)
RIPng config>timers <update-time> <timeout-timer> <garbage-timer> ?
<cr>
RIPng config>

```

The three RIPng timers are:

- **Routing table update timer.** Default is 30 seconds. This is the time lapse between periodic response sending.
- **Routing information timeout timer.** Default is 180 seconds. If this time lapses without an IPv6 route being refreshed by a response, the route becomes invalid.
- **Garbage collection timer.** Default is 120 seconds. Once the above time has lapsed, the route is considered invalid and will remain in the routing table with a metric of 16 (unreachable) during the time defined in this timer. During this time period, said route is included in RIPng messages with a metric of 16 (unreachable) so neighboring routers know this path will be deleted.

*Example:*

```
RIPng config>timers 30 56 87
RIPng config>
```

In this example the **routing table update timer** is set to 30, the **routing information timeout timer** to 56 and the **garbage collection timer** to 87.

## 2.1.8 vrf

Accesses a specified VRF RIPng configuration. On accessing a VRF RIPng configuration menu, the prompt changes to **RIPng vrf config>**. Use the **exit** command to return to the main VRF RIPng configuration.

*Syntax:*

```
RIPng config>vrf ?
<1..32 chars>   VPN Routing/Forwarding instance name
RIPng config>
```

*Example:*

```
RIPng config>vrf vl
-- RIPng protocol user configuration for a VRF --
RIPng vrf config>
```

**Command history:**

Release	Modification
11.01.09	This command was introduced as of version 11.01.09.

## 2.1.9 exit

Use the **exit** command to return to the previous prompt level.

*Syntax:*

```
RIPng config>exit ?
<cr>
RIPng config>
```

*Example:*

```
RIPng config>exit
config>
```

## 2.2 RIPng Commands per Interface

This section specifies the configuration commands relative to RIPng, which are available in the configuration menus for interfaces supporting RIPng. To access the available RIPng commands per interface, execute the following:

```
config>network <interface>
-- <interface> Interface User Configuration --
<interface> config>ipv6 ripng ?
  enable           Enable/disable RIPng routing
  metric-offset    Adjust default metric increment
  passive          Suppress routing updates on this interface
  poison-reverse   Poison reverse updates
  split-horizon    Split horizon updates
ethernet0/0 config>
```

Command	Function
? (HELP)	Lists the commands and their options.
ENABLE	Enables RIPng in the interface.
METRIC-OFFSET	Establishes the metric increment.

<b>PASSIVE</b>	Establishes the interface as passive.
<b>POISON-REVERSE</b>	Enables <b>poison reverse</b> .
<b>SPLIT-HORIZON</b>	Enables <b>split horizon</b> .

## 2.2.1 ? (HELP)

Use “?” (HELP) to list the valid commands at the level where the router is programmed. You can also use it after a specific command to list the available options:

*Syntax:*

```
<interface> config>ipv6 ripng ?
<interface> config>
```

*Example:*

```
ethernet0/0 config>ipv6 ripng ?
  enable           Enable/disable RIPng routing
  metric-offset    Adjust default metric increment
  passive          Suppress routing updates on this interface
  poison-reverse   Poison reverse updates
  split-horizon    Split horizon updates
ethernet0/0 config>
```

## 2.2.2 enable

The **enable** subcommand enables RIPng in the interface. You need to enable **unicast-routing** in order for RIPng to work.

*Syntax:*

```
ethernet0/0 config>ipv6 ripng enable ?
  <cr>
ethernet0/0 config>
```

*Example:*

- **Enabling the unicast routing option:**

```
config>protocol ipv6
IPv6 config>unicast-routing
IPv6 config>exit
config>
```

- **Enabling RIPng in the ethernet0/0 interface:**

```
config>network ethernet0/0
ethernet0/0 config>ipv6 ripng enable
ethernet0/0 config>exit
config>
```

## 2.2.3 metric-offset

Establishes the metric increment carried out in the routes learned from the RIPng **Response** messages received on the interface. The default value is 1.

*Syntax:*

```
<interface> config>ipv6 ripng metric-offset ?
  <1..16>    Value in the specified range
<interface> config>
```

*Example:*

```
ethernet0/0 config>ipv6 ripng metric-offset 6
ethernet0/0 config>
```

Establishes a metric increment of 6 in the routes learned from the RIPng RESPONSE messages received on the ethernet0/0 interface.

## 2.2.4 passive

Sets the interface to behave in passive mode with respect to RIPng. Passive mode allows you to update the IPv6 routing table with the RIPng **Response** messages received by the passive interface, but it does not send any RIPng **Response** messages through said interface. It also ignores RIPng **Request** messages received from neighboring routers.

### Syntax:

```
<interface> config>ipv6 ripng passive ?  
<cr>  
<interface> config>
```

### Example:

```
ethernet0/0 config>ipv6 ripng passive  
ethernet0/0 config>
```

## 2.2.5 poison-reverse

Allows you to enable or disable the **poison reverse** algorithm in the interface. When enabled, routes learned from a given gateway are announced with an infinite metric of 16 (unreachable) in the link where they have been learned. This is better when enabled as protocol convergence is faster. By default, the **poison reverse** algorithm is disabled.

### Syntax:

```
<interface> config>ipv6 ripng poison-reverse ?  
<cr>  
<interface> config>
```

### Example:

```
ethernet0/0 config>ipv6 ripng poison-reverse  
ethernet0/0 config>
```

## 2.2.6 split-horizon

Allows you to enable or disable the **split horizon** algorithm in the interface. If enabled, no notifications or updates about a route are sent by RIPng towards the very network where the route was learned. By default, **split horizon** is enabled.

### Syntax:

```
<interface> config>ipv6 ripng split-horizon ?  
<cr>  
<interface> config>
```

### Example:

```
ethernet0/0 config>no ipv6 ripng split-horizon  
ethernet0/0 config>
```

## Chapter 3 Monitoring

### 3.1 RIPng Monitoring Commands

This chapter describes the commands used to monitor RIPng. To access the protocol monitoring environment, enter the following sequence of commands:

```
*monitor
Console Operator
+protocol ripng
-- RIPng protocol monitor --
RIPng+
```

This menu contains the following options:

Command	Function
? (HELP)	Lists the commands or their options.
LIST-ROUTES	Lists RIPng routes
STATUS	Displays the status of the RIPng
VRF	Enters the RIPng monitoring menu for a VPN Routing/Forwarding instance.
EXIT	Returns to the previous menu

#### 3.1.1 ?(HELP)

Use this command to list the valid commands at the prompt where you are working. You can also use it after a specific command to list the available options:

**Syntax:**

```
RIPng+?
```

**Example:**

```
RIPng+?
 list-routes   List RIPng routes
 status       Show RIPng status
 vrf          RIPng in a VPN Routing/Forwarding instance
 exit
RIPng+
```

#### 3.1.2 LIST-ROUTES

The **list-routes** command displays information on IPv6 routes managed by RIPng. The information on IPv6 routes is managed in columns; the meaning of each is as follows:

- **Codes.** Displays the source of the IPv6 route. There are different possibilities:
  - RIPng: This is a route learned from the RIPng.
  - BGP: This is a route learned through BGP.
  - OSPFv3: This is a route learned through the OSPFv3 protocol.
  - Static: This is a static route.
  - Connected: This is a directly connected route.
- **Network.** Displays the IPv6 route.
- **Next hop.** Displays the next hop to reach the IPv6 route indicated in **Network**.
- **Via.** Indicates through which interface the IPv6 route is accessible.
- **Metric.** Indicates the IPv6 route metric.
- **Tag.** Displays the IPv6 route tag.
- **Time.** Displays the valid time for the IPv6 route. If no time has been entered, the route is considered to be indefinitely valid.

**Syntax:**

```
RIPng+list-routes
```

**Example:**

```
RIPng+list-routes
Codes: C - Connected, S - Static, B - BGP, O - OSPFv3, R - RIPng

  Network                Next Hop                Via                Metric  Tag    Time
R  2001:db8:1111::/64    fe80::2a0:26ff:fe44:0  ethernet0/0        2       0     02:40
R  2001:db8:1234::/64    fe80::2a0:26ff:fe44:0  ethernet0/0        2       0     02:40
R  2001:db8:2222::/64    fe80::2a0:26ff:fe4e:5a20 ethernet0/0        2       0     02:26
R  2001:db8:3333::1/128  fe80::2a0:26ff:fe4e:5a20 ethernet0/0        2       0     02:26
R  2001:db8:4321::/64    fe80::2a0:26ff:fe44:0  ethernet0/0        2       0     02:40
S  2001:db8:6543::/64    ::                      internal            1       0
R  2001:db8:7777::/64    fe80::2a0:26ff:fe44:0  ethernet0/0        2       0     02:40
C  2001:db8:7f43::/64    ::                      internal            1       0
R  2001:db8:8888::/64    fe80::2a0:26ff:fe44:0  ethernet0/0        10      0     02:39
R  2001:db8:9999::/64    fe80::2a0:26ff:fe44:0  ethernet0/0        10      0     02:39
C  2001:db8:ab55::/64    ::                      internal            1       0
C  2001:db8:c887::/64    ::                      internal            1       0
RIPng+
```

### 3.1.3 STATUS

Displays the status of the RIPng routing protocol. The information available through this command is as follows:

- RIPng timers (described in the section on configuring the **timers**).
- Interfaces where RIPng is enabled.
- Information on neighboring routers, which have provided updates for the IPv6 routing table through RIPng **Response** messages. This also provides the time lapsed since the last update from each neighbor.

**Syntax:**

```
RIPng+status
```

**Example:**

```
RIPng+status
Updates interval: 30 seconds, next update in 26 seconds
Timeout timer: 180 seconds
Garbage collection timer: 120 seconds
Default redistribution metric is 1
Default version control: send version 1, receive version 1
Routing for Networks:
  ethernet0/0
  ethernet0/0.87
Routing Information Sources:
  Gateway                BadPackets  BadRoutes  Distance  Last_Update
  fe80::2a0:26ff:fe44:0    0            0          120       00:00:03
  fe80::2a0:26ff:fe4e:5a20 0            0          120       00:00:32
RIPng+
```

The following information is shown in this example:

- Information on RIPng timers (20, 180 and 120). Time remaining to send an updating message (RIPng **Response**) is 26 seconds.
- The RIPng is enabled in the following interfaces: ethernet0/0 and ethernet0/0.87.
- Updates from the following routers have been received: **fe80::2a0:26ff:fe44:0** and **fe80::2a0:26ff:fe4e:5a20**. The last RIPng **Response** from neighbor **fe80::2a0:26ff:fe44:0** was received 3 seconds ago and the last RIPng **Response** from neighbor **fe80::2a0:26ff:fe4e:5a20** was received 32 seconds ago.

### 3.1.4 VRF

Accesses a specified VRF RIPng monitoring menu. On accessing a VRF RIPng monitoring menu, the prompt changes to **RIPng vrf+**. Use the **exit** command to return to the main VRF RIPng monitoring menu.

**Syntax:**

```
RIPng+vrf ?
<1..32 chars>   VPN Routing/Forwarding instance name
RIPng+
```

**Example:**

```
RIPng+vrf v1

RIPng vrf+
```

**Command history:**

Release	Modification
11.01.09	This command was introduced as of version 11.01.09.

## 3.2 Another way of monitoring RIPng

Another way of monitoring RIPng routes is through the **list route** command, found in the IPv6 monitoring menu.

**Syntax:**

```
*monitor
Console Operator
+protocol ipv6
-- IPv6 protocol monitor --
IPv6+list route
```

**Example:**

```
IPv6+list route
Codes: C - Connected, S - Static, R - RIPng, O - OSPFv3 Intra, OI - OSPFv3 Inter,
       OE1 - OSPFv3 ext 1, OE2 - OSPFv3 ext 2, B - BGP, * - Active

C* 2001:db8:1111::/64 [0/1] is directly connected, ethernet0/0
C* 2001:db8:2222::/64 [0/1] is directly connected, ethernet0/1
R* 2001:db8:3333::/64 [100/6] via fe80::2a0:26ff:fe4e:5a20, ethernet0/0
S* 2001:db8:4321::/64 [1/0] is directly connected, ethernet0/0
```

For further information on this command, please see manual Teldat Dm805-I IPv6 Addressing.

## Chapter 4 Events

### 4.1 Monitoring through Events

You can view information relative to a subsystem or for a particular event through **events**.

The subsystem relative to RIPng is RIP6.

To enable/disable events relative to RIPng, carry out the following sequence of steps in either the **static** or **dynamic** configuration sector.

```
config>event
-- ELS Config --
ELS config>{enable}|{disable} trace subsystem rip6 [<level>]
```

Where:

- *level*. Indicates the threshold after which the events relative to the specified subsystem are displayed. Some of the most common register levels are *standard*, *error*, *info* or *all*.

Where you want to enable/disable an event corresponding to a specific subsystem, the command syntax is as follows:

```
{enable}|{disable} trace event <event>
```

Where:

- *event*. This is the identifier for the event you are referring to. It's syntax is defined by the expression:

```
{rip6}.<number>
```

Where <number> is the index for the event in the specified subsystem.

If you require more information on one of the above subsystems, please see the manual associated with each of them.



## Chapter 5 Example

### 5.1 RIPng Protocol: Configuration Example

The following section presents a simple example showing a possible user scenario for RIPng. This scenario is reflected in Figure 3.

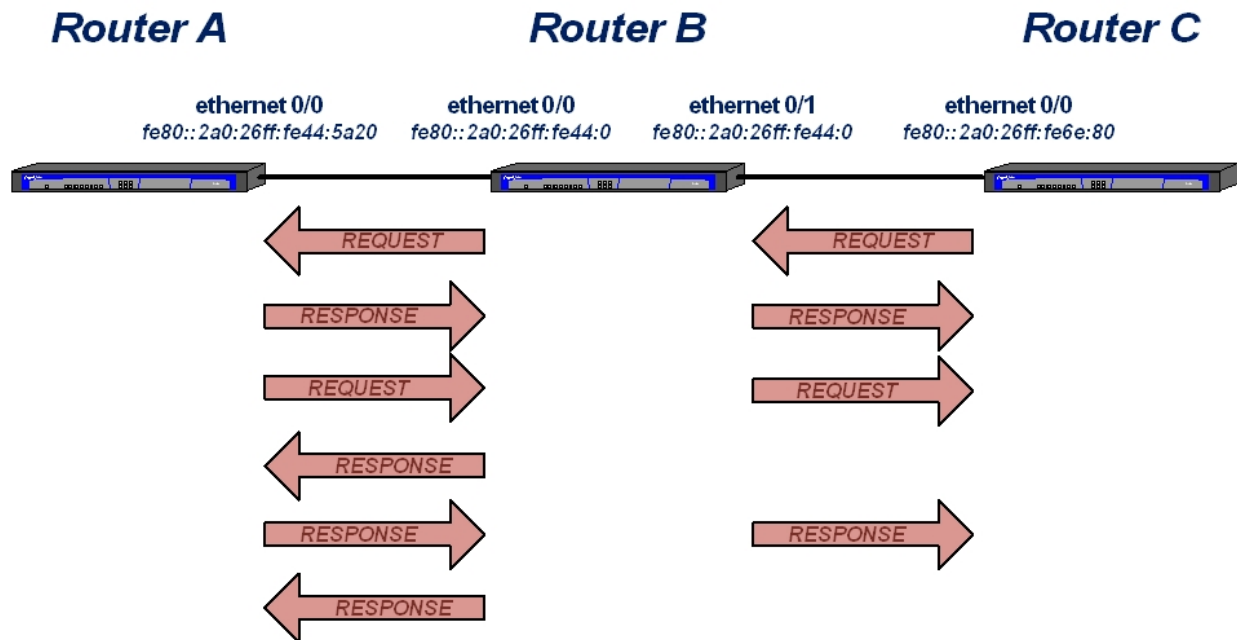


Fig. 3: Scenario 1: Exchanging IPv6 routes between 3 routers using RIPng.

When RIPng is enabled in an interface, it sends a **Request** message on an interface that is not passive with respect to RIPng, it will send a **Response** message addressed to the router that sent the **Request**, together with its routing table. The routers periodically send **Response** messages to all neighbors to report their routing tables. A router that detects a change to its routing table immediately sends a **Response** message to inform all the other routers of that change.

The configuration needed for the three routers in Scenario 1 is as follows:

#### Router A: Configuration

```
log-command-errors
no configuration
add device loopback 2
network ethernet0/0

; -- Ethernet Interface User Configuration --
  ipv6 enable
  ipv6 address 2001:db8:3333::1/64
  ipv6 ripng enable
  ipv6 nd ra lifetime 0
  no ipv6 ripng split-horizon
exit
;
;
event
; -- ELS Config --
  enable trace subsystem RIP6 ALL
exit
;
protocol ipv6
; -- IPv6 user configuration --
  unicast-routing
exit
;
; protocol ripng
```

```

; -- RIPng protocol user configuration --
    redistribute connected
    redistribute static
    exit
;    dump-command-errors
    end

```

### Router B: Configuration

```

log-command-errors
no configuration
network ethernet0/0

; -- Ethernet Interface User Configuration --
    ipv6 enable
    ipv6 address 2001:db8:1111::1/64
    ipv6 ripng enable
    ipv6 ripng metric-offset 5
    ipv6 nd ra lifetime 0
    no ipv6 ripng split-horizon
    exit

;
network ethernet0/1
; -- Ethernet Interface User Configuration --
    ipv6 enable
    ipv6 address 2001:db8:2222::1/64
    ipv6 ripng enable
    ipv6 ripng metric-offset 8
    ipv6 nd ra lifetime 0
    no ipv6 ripng split-horizon
    exit
;
    event

; -- ELS Config --
    enable trace subsystem RIP6 ALL
    exit
;
    protocol ipv6
; -- IPv6 user configuration --
    route 2001:db8:4321::/64 interface ethernet0/0
    unicast-routing
    exit
;
;
    protocol ripng
; -- RIPng protocol user configuration --
    route 2001:db8:1234::/64
;
    redistribute connected
    redistribute static
    exit
;    dump-command-errors
    end

```

### Router C: Configuration

```

log-command-errors
no configuration
set data-link at cellular0/0
set data-link at cellular0/1
network ethernet0/0
; -- Ethernet Interface User Configuration --
    ipv6 enable
    ipv6 address 2001:db8:4444::1/64
    ipv6 ripng enable
    ipv6 ripng passive

```

```
    ipv6 nd ra lifetime 0
    no ipv6 ripng split-horizon
  exit
;  event
; -- ELS Config --
    enable trace subsystem RIP6 ALL
  exit
;
protocol ipv6
; -- IPv6 user configuration --
    unicast-routing
  exit
;
;
  protocol ripng
; -- RIPng protocol user configuration --
    redistribute connected
    redistribute static
  exit
;
  dump-command-errors
end
```