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# **ZebOS-XP®**

## **Network Platform**

**Version 1.4**

**Extended Performance**

### **Bidirectional Forwarding Detection Configuration Guide**

**December 2015**

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# Preface

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This guide describes how to configure Bidirectional Forwarding Detection (BFD) in ZebOS-XP.

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## Audience

This guide is intended for network administrators and other engineering professionals who configure BFD.

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## Conventions

Table P-1 shows the conventions used in this guide.

**Table P-1: Conventions**

Convention	Description
<i>Italics</i>	Emphasized terms; titles of books
Note:	Special instructions, suggestions, or warnings
<code>monospaced type</code>	Code elements such as commands, functions, parameters, files, and directories

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## Contents

This document contains these chapters and appendices:

- [Chapter 1, Base BFD Configuration](#)
- [Chapter 2, BFD Protocol Configurations](#)
- [Chapter 3, BFD Static Route Configuration](#)
- [Chapter 4, BFD for MPLS LSPs](#)
- [Chapter 5, BFD Authentication](#)

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## Related Documents

Use this guide with the *Bidirectional Forwarding Detection Command Reference* for details about the commands used in the configurations.

Note: All ZebOS-XP technical manuals are available to licensed customers at [http://www.ipinfusion.com/support/document\\_list](http://www.ipinfusion.com/support/document_list).

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## Chapter Organization

The chapters in this guide are organized into these major sections:

- An overview that explains a configuration in words
- Topology with a diagram that shows the devices and connections used in the configuration
- Configuration steps in a table for each device where the left-hand side shows the commands you enter and the right-hand side explains the actions that the commands perform
- Validation which shows commands and their output that verify the configuration

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## Support

For support-related questions, contact [support@ipinfusion.com](mailto:support@ipinfusion.com).

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## Comments

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## CHAPTER 1 Base BFD Configuration

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This chapter provides the steps for configuring the base Bidirectional Forwarding Detection (BFD) setup.

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### Topology



Figure 1-1: Basic Topology of Three Routers

### BFD Echo Function

Router#configure terminal	Enter the Configure mode.
Router(config)#bfd echo	Enable BFD echo mode.

### BFD Slow Timer

Router#configure terminal	Enter the Configure mode.
Router(config)#bfd slow-timer 1000	Configure BFD slow-timer in milliseconds.

### BFD Multihop Peer Timer

Router#configure terminal	Enter Configure mode.
Router(config)#bfd multihop-peer 20.1.1.3 interval 100 minrx 100 multiplier 3	Configure BFD multihop-peer timer and reception intervals in milliseconds and the Hello multiplier.

### BFD Single-hop Session Timer

Router#configure terminal	Enter the Configure mode.
Router(config)#interface eth1	Enter the Interface mode.
Router(config-if)#bfd interval 100 minrx 100 multiplier 4	Configure BFD single-hop sessions timer and reception interval in millisecond and the Hello multiplier.

### BFD Echo Interval

Router#configure terminal	Enter the Configure mode.
Router(config)#interface eth1	Enter the Interface mode.
Router(config-if)#bfd echo interval 100	Configure BFD echo interval in milliseconds.





## CHAPTER 2 BFD Protocol Configurations

This chapter describes the BFD protocol configurations.

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### OSPF—BFD Single-Hop Session

This section provides the steps for configuring BFD for Single-Hop OSPF.

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#### Topology

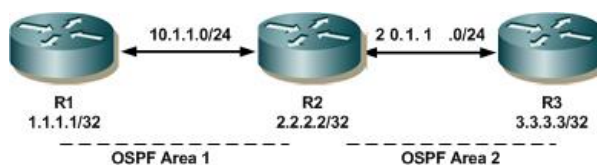


Figure 2-1: Single-Hop OSPF Topology

#### Configuration for R1

R1#configure terminal	Enter the Configure mode.
R1(config)#router ospf 100	Enter the Router mode for OSPF.
R1(config-router)#network 10.1.1.0/24 area 1	Advertise network 10.1.1.0/24 in OSPF area 1.
R1(config-router)#network 1.1.1.1/32 area 1	Advertise loopback network 1.1.1.1/32 in OSPF area 1.
R1(config-router)#bfd all-interfaces	Enable BFD for all neighbors.

#### Configuration for R2

R2#configure terminal	Enter the Configure mode.
R2(config)#router ospf 100	Enter the Router mode for OSPF.
R2(config-router)#network 10.1.1.0/24 area 1	Advertise network 10.1.1.0/24 in OSPF area 1.
R2(config-router)#network 20.1.1.0/24 area 1	Advertise network 20.1.1.0/24 in OSPF area 1.
R2(config-router)#network 2.2.2.2/32 area 1	Advertise loopback network 2.2.2.2/32 in OSPF area 1.
R2(config-router)#bfd all-interfaces	Enable BFD for all neighbors.

#### Configuration for R3

R3#configure terminal	Enter the Configure mode.
R3(config)#router ospf 100	Enter the Router mode for OSPF.
R3(config-router)#network 20.1.1.0/24 area 1	Advertise network 20.1.1.0/24 in OSPF area 1.

R3(config-router)#network 3.3.3.3/32 area 1	Advertise loopback network 3.3.3.3/32 in OSPF area 1.
R3(config-router)#bfd all-interfaces	Enable BFD for all neighbors

### Validation

The example that follows is the output of the command:

```
R2#show bfd session
Session Interface Index : 3      Session Index: 1
Lower Layer: IPv4      Single Hop
Session State : Up
Local Discriminator : 1 Remote Discriminator: 1
Local Address : 10.1.1.67/32    Remote Address: 10.1.1.66/32
Local Port : 49152      Remote Port: 3784
Timers in Milliseconds
Min Tx: 20 Min Rx: 20 Multiplier: 5
UP Count: 1 UPTIME: 00:14:12
Session Interface Index : 4      Session Index: 4
Lower Layer: IPv4      Single Hop
Session State : Up
Local Discriminator : 4 Remote Discriminator: 4
Local Address : 20.1.1.67/32    Remote Address: 20.1.1.68/32
Local Port : 49155      Remote Port: 3784
Timers in Milliseconds
Min Tx: 20 Min Rx: 20 Multiplier: 5
UP Count: 1 UPTIME: 00:01:12
Number of Sessions:      2
```

## OSPF—BFD Multi-Hop Session

This section provides the steps for configuring BFD for OSPF multi-hop sessions.

### Topology

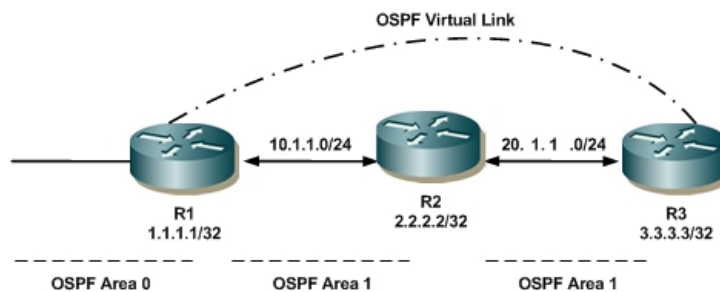


Figure 2-2: Multi-hop OSPFv3 Topology

### Configuration for R1

R1#configure terminal	Enter the Configure mode.
R1(config)#router ospf 100	Enter the Router mode for OSPF.
R1(config-router)#network 10.1.1.0/24 area 1	Advertise network 20.1.1.0/24 in OSPF area 1.
R1(config-router)#network 1.1.1.1/32 area 1	Advertise loopback network 1.1.1.1/32 in OSPF area 1.
R1(config-router)#network 30.1.1.0/24 area 0	Advertise network 30.1.1.0/24 in OSPF area 0.
R1(config-router)#area 1 virtual-link 3.3.3.3 fall-over bfd	Create a virtual link to R3 with BFD.

### Configuration for R2

R2#configure terminal	Enter the Configure mode
R2(config)#router ospf 100	Enter the Router mode for OSPF.
R2(config-router)#network 10.1.1.0/24 area 1	Advertise network 10.1.1.0/24 in OSPF area 1.
R2(config-router)#network 20.1.1.0/24 area 1	Advertise network 20.1.1.0/24 in OSPF area 1.
R2(config-router)#network 2.2.2.2/32 area 1	Advertise loopback network 2.2.2.2/32 in OSPF area 1.

## Configuration for R3

R3#configure terminal	Enter the Configure mode.
R3(config)#router ospf 100	Enter the Router mode for OSPF.
R3(config-router)#network 20.1.1.0/24 area 1	Advertise network 20.1.1.0/24 in OSPF area 1.
R3(config-router)#network 3.3.3.3/32 area 1	Advertise loopback network 3.3.3.3/32 in OSPF area 1.
R3(config-router)#area 1 virtual-link 1.1.1.1 fall-over bfd	Create a virtual link to R1 with BFD.

## Validation

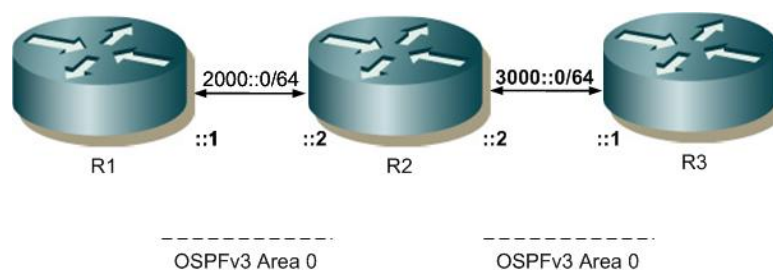
The example that follows is the output of the command:

```
R1#show bfd session
Session Interface Index : 0      Session Index: 2
Lower Layer:  IPv4      Multihop Arbit Path
Session State : Up
Local Discriminator : 2 Remote Discriminator: 1
Local Address : 10.1.1.66/32 Remote Address: 20.1.1.68/32
Local Port : 49153 Remote Port: 4784
Min Tx: 2 Min Rx: 20 Multiplier: 5
UP Count: 1 UPTIME: 00:03:58
Number of Sessions: 1
```

## OSPFv3—BFD Single-Hop Session

This section provides the steps for configuring BFD for single-hop OSPFv3.

## Topology



**Figure 2-3: Single-Hop OSPFv3 Topology**

**Configuration for R1**

R1#configure terminal	Enter the Configure mode.
R1(config)#interface eth1	Enter the Interface mode for eth1.
R1(config-if)#ipv6 address 2000::1/64	Configure IPv6 address for the interface eth1.
R1(config-if)#ipv6 router ospf area 0	Enable OSPFv3 on the interface in area 0.
R1(config-if)#exit	Exit from the Interface mode.
R1(config)#router ipv6 ospf 100	Enter the Router mode for OSPFv3.
R1(config-router)#router-id 1.1.1.1	Configure OSPFv3 Router-ID.
R1(config-router)#bfd all-interfaces	Enable BFD on all OSPFv3 enabled interfaces.
R1(config-router)#exit	Exit from the Router mode.

**Configuration for R2**

R2#configure terminal	Enter the Configure mode.
R2(config)#interface eth1	Enter the Interface mode eth1.
R2(config-if)#ipv6 address 2000::2/64	Configure IPv6 address for the interface eth1.
R2(config-if)#ipv6 router ospf area 0	Enable OSPFv3 on the interface in area 0.
R2(config-if)#exit	Exit from the Interface mode.
R2(config)#interface eth2	Enter the Interface mode for eth2.
R2(config-if)#ipv6 address 3000::2/64	Configure IPv6 address for the interface eth2.
R2(config-if)#ipv6 router ospf area 0	Enable OSPFv3 on the interface in area 0.
R2(config-if)#exit	Exit from the Interface mode.
R2(config)#router ipv6 ospf 100	Enter the Router mode for OSPFv3.
R2(config-router)#router-id 2.2.2.2	Configure OSPFv3 Router-ID.
R2(config-router)#bfd all-interfaces	Enable BFD on all OSPFv3 enabled interfaces.
R2(config-router)#exit	Exit from the Router mode.

**Configuration for R3**

R3#configure terminal	Enter the Configure mode.
R3(config)#interface eth1	Enter the Interface mode for eth1.
R3(config-if)#ipv6 address 3000::1/64	Configure IPv6 address for the interface eth1.
R3(config-if)#ipv6 router ospf area 0	Enable OSPFv3 on the interface in area 0.
R3(config-if)#exit	Exit from the Interface mode.
R3(config)#router ipv6 ospf 100	Enter the Router mode for OSPFv3.
R3(config-router)#router-id 3.3.3.3	Configure OSPFv3 Router-ID.
R3(config-router)#bfd all-interfaces	Enable BFD on all OSPFv3 enabled interfaces.
R3(config-router)#exit	Exit from the Router mode.

## Validation

This section provides the output of show commands used to confirm the configurations for BFD for single-hop OSPFv3.

### R2#show bfd session

Sess-Idx	Remote-Disc	Lower-Layer	Sess-Type	Sess-State	UP-Time	Remote-Addr
20	12	IPv6	Single-Hop	Up	00:00:33	fe80::5054:ff:fe31:3233/128
21	1	IPv6	Single-Hop	Up	00:00:26	fe80::7074:ff:fe72:7374/128

Number of Sessions: 2

### R2#show bfd session detail

```

Session Interface Index : 3
Lower Layer : IPv6
Session Type : Single Hop
Local Discriminator : 10
Remote Discriminator : 12
Local Port : 49161
Options :

Session Index : 10
Version : 1
Session State : Up
Local Address : fe80::5054:ff:fe31:3233/128
Remote Address : fe80::7074:ff:fe72:7374/128
Remote Port : 13784

```

Diagnostics : None

#### Timers in Milliseconds :

Min Tx: 1000	Min Rx: 1000	Multiplier: 2
Neg Tx: 1000	Neg Rx: 1000	Neg detect mult: 2
Min echo Tx: 20	Min echo Rx: 10	Neg echo intrvl: 0
Storage type : 2		
Sess down time : 00:00:00		
Sess discontinue time : 00:00:00		
Bfd GTSM Disabled		
Bfd Authentication Disabled		

#### Counters values:

Pkt In : 0000000000000000	Pkt Out : 0000000000000000
Echo Out : 0000000000000000	IPv6 Echo Out : 0000000000000000
IPv6 Pkt In : 0000000000000494	IPv6 Pkt Out : 00000000000004e3
UP Count : 4	UPTIME : 00:15:09

#### Protocol Client Info:

OSPF6-> Client ID: 5      Flags: 4

```

Session Interface Index : 3
Lower Layer : IPv4
Session Type : Single Hop
Local Discriminator : 19
Remote Discriminator : 13
Local Port : 49170

Session Index : 19
Version : 1
Session State : Up
Local Address : 2.2.2.1/32
Remote Address : 2.2.2.2/32
Remote Port : 3784

```

Options :

Diagnostics : None

Timers in Milliseconds :

Min Tx: 1000	Min Rx: 1000	Multiplier: 2
Neg Tx: 1000	Neg Rx: 1000	Neg detect mult: 2
Min echo Tx: 20	Min echo Rx: 10	Neg echo intrvl: 0
Storage type : 2		
Sess down time : 00:00:00		
Sess discontinue time : 00:00:00		
Bfd GTSM Disabled		
Bfd Authentication Disabled		

Counters values:

Pkt In : 0000000000000006f	Pkt Out : 0000000000000006c
Echo Out : 0000000000000000	IPv6 Echo Out : 0000000000000000
IPv6 Pkt In : 0000000000000000	IPv6 Pkt Out : 0000000000000000
UP Count : 1	UPTIME : 00:01:36

Protocol Client Info:

RIP-> Client ID: 2           Flags: 4

-----  
Number of Sessions:     2

## OSPFv3—BFD Multi-Hop Sessions

This section provides the steps for configuring BFD for OSPFv3 multi-hop sessions.

### Topology

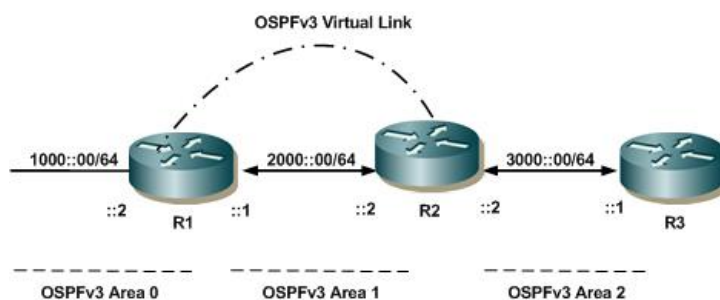


Figure 2-4: Multi-Hop OSPFv3 Topology

### Configuration for R1

R1#configure terminal	Enter the Configure mode.
R1(config)#interface eth2	Enter the Interface mode eth2.
R1(config-if)#ipv6 address 1000::1/64	Configure IPv6 address for the interface eth2.
R1(config-if)#ipv6 router ospf area 0	Enable OSPFv3 on the interface in area 0.
R1(config-if)#exit	Exit from the Interface mode.
R1(config)#interface eth1	Enter the Interface mode for eth1.
R1(config-if)#ipv6 address 2000::1/64	Configure IPv6 address for the interface eth1.
R1(config-if)#ipv6 router ospf area 1	Enable OSPFv3 on the interface in area 1.
R1(config-if)#exit	Exit from the Interface mode.
R1(config)#router ipv6 ospf 100	Enter the Router mode for OSPFv3.
R1(config-router)#router-id 1.1.1.1	Configure OSPFv3 Router-ID.
R1(config-router)#area 1 virtual-link 2.2.2.2 fall-over bfd	Create an OSPFv3 virtual-link to R2 with BFD.
R1(config-router)#exit	Exit from the Router mode.

### Configuration for R2

R2#configure terminal	Enter the Configure mode.
R2(config)#interface eth1	Enter the Interface mode eth1.
R2(config-if)#ipv6 address 2000::2/64	Configure IPv6 address for the interface eth1.
R2(config-if)#ipv6 router ospf area 1	Enable OSPFv3 on the interface in area 1.
R2(config-if)#exit	Exit from the Interface mode.
R2(config)#interface eth2	Enter the Interface mode for eth2.
R2(config-if)#ipv6 address 3000::2/64	Configure IPv6 address for the interface eth2.
R2(config-if)#ipv6 router ospf area 2	Enable OSPFv3 on the interface in area 2.
R2(config-if)#exit	Exit from the Interface mode.



R2(config)#router ipv6 ospf 100	Enter the Router mode for OSPFv3.
R2(config-router)#router-id 2.2.2.2	Configure OSPFv3 Router-ID.
R2(config-router)#area 1 virtual-link 1.1.1.1 fall-over bfd	Create an OSPFv3 virtual-link to R1 with BFD.
R2(config-router)#exit	Exit from the Router mode.

### Configuration for R3

R3#configure terminal	Enter the Configure mode.
R3(config)#interface eth1	Enter the Interface mode for eth1.
R3(config-if)#ipv6 address 3000::1/64	Configure IPv6 address for the interface eth1.
R3(config-if)#ipv6 router ospf area 2	Enable OSPFv3 on the interface in area 2.
R3(config-if)#exit	Exit from the Interface mode.
R3(config)#router ipv6 ospf 100	Enter the Router mode for OSPFv3.
R3(config-router)#router-id 3.3.3.3	Configure OSPFv3 Router-ID.
R3(config-router)#exit	Exit from the Router mode.

### Validation

This section provides the output of show commands used to confirm the configurations for BFD for OSPFv3 multi-hop sessions.

#### R3#show bfd session

```

Sess-Idx   Remote-Disc  Lower-Layer  Sess-Type   Sess-State  UP-Time   Remote-Addr
14         24              IPv6          Multi-Hop   Up
00:01:14   2000::2/128
Number of Sessions:    1

```

#### R3#show bfd session detail

=====

```

Session Interface Index : 3           Session Index : 10
Lower Layer : IPv6                  Version : 1
Session Type : Multi Hop            Session State : Up
Local Discriminator : 10             Local Address : 2000::1/128
Remote Discriminator : 12            Remote Address : 2000::2/128
Local Port : 49161                  Remote Port : 13784
Options :

```

Diagnostics : None

#### Timers in Milliseconds :

```

Min Tx: 1000           Min Rx: 1000           Multiplier: 2
Neg Tx: 1000           Neg Rx: 1000           Neg detect mult: 2
Min echo Tx: 20        Min echo Rx: 10       Neg echo intrvl: 0
Storage type : 2
Sess down time : 00:00:00
Sess discontinue time : 00:00:00
Bfd GTSM Disabled

```

Bfd Authentication Disabled

Counters values:

Pkt In : 0000000000000000

Echo Out : 0000000000000000

IPv6 Pkt In : 0000000000000494

UP Count : 4

Pkt Out : 0000000000000000

IPv6 Echo Out : 0000000000000000

IPv6 Pkt Out : 00000000000004e3

UPTIME : 00:15:09

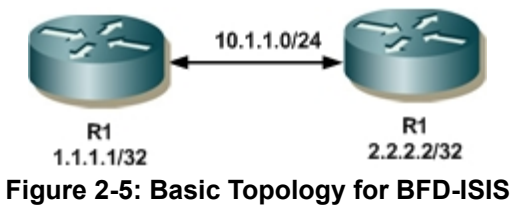
Protocol Client Info:

OSPF6-> Client ID: 5      Flags: 4

## BFD Configuration in IS-IS

This section provides the steps for configuring BFD for the IS-IS protocol.

### Topology



#### Configuration for R1

R1#configure terminal	Enter the Configure mode.
R1(config)#router isis	Enter the Router mode for IS-IS.
R1(config-router)#net 10.0000.0000.0001.00	Advertise network 10.0000.0000.0001.00 in IS-IS.
R1(config-router)#bfd all-interface	Enable BFD for all neighbors.

#### Configuration for R2

R2#configure terminal	Enter the Configure mode.
R2(config)#router isis	Enter the Router mode for IS-IS.
R2(config-router)#net 10.0000.0000.0002.00	Advertise network 10.0000.0000.0001.00 in IS-IS.
R2(config-router)#bfd all-interface	Enable BFD for all neighbors.

## BFD Configuration in BGP

This section provides the steps for configuring BFD for the BGP protocol.

### Topology



Figure 2-6: Basic Topology for BFD in BGP

### Configuration for R1

R1#configure terminal	Enter the Configure mode.
R1(config)#router bgp 100	Enter the Router mode for BGP.
R1(config-router)#neighbor 3.3.3.3 remote-as 100	Add the neighbor 3.3.3.3/32 to remote-as 100
R1(config-router)#neighbor 3.3.3.3 fall-over bfd multihop	Enable the BFD option for the neighbor.

### Configuration for R2

R2#configure terminal	Enter the Configure mode.
R2(config)#router bgp 100	Enter the Router mode for BGP.
R2(config-router)#neighbor 2.2.2.2 remote-as 100	Add the neighbor 2.2.2.2 to remote-as 100.
R2(config-router)#neighbor 2.2.2.2 fall-over bfd multihop	Enable the BFD option for the neighbor.

### Configuration for R3

R3#configure terminal	Enter the Configure mode.
R3(config)#router bgp 100	Enter the Router mode for BGP.
R3(config)#router bgp 100	Configure BGP.
R3(config-router)#neighbor 1.1.1.1 remote-as 100	Add the neighbor 1.1.1.1 to remote-as 100.
R3(config-router)#neighbor 1.1.1.1 fall-over bfd multihop	Enable the BFD option for the neighbor.

# BFD Configuration in RIP

This section provides the steps for configuring BFD for the RIP protocol.

## Topology



Figure 2-7: Basic Topology for BFD in RIP

### Configuration for R1

R1#configure terminal	Enter the Configure mode.
R1(config)#router rip	Enter the Router mode for RIP.
R1(config-router)#network 10.1.1.0/24	Advertise network 10.1.1.0/24 in RIP.
R1(config-router)#bfd all-interfaces	Enable BFD for all neighbors.
	or
R1(config-router)#neighbor 10.1.1.2 fall-over bfd	Enable BFD for a specific RIP neighbor

### Configuration for R2

R2#configure terminal	Enter the Configure mode.
R2(config)#router rip	Enter the Router mode for RIP.
R2(config-router)#network 10.1.1.0/24	Advertise network 10.1.1.0/24 in RIP.
R2(config-router)#bfd all-interfaces	Enable BFD for all neighbors.
	or
R2(config-router)#neighbor 10.1.1.1 fall-over bfd	Enable BFD for a specific RIP neighbor.

### Validation

This section provides the output of show commands used to confirm the configurations for BFD for the RIP protocol.

```
R1#show bfd session
Sess-Idx  Remote-Disc  Lower-Layer  Sess-Type  Sess-State  UP-Time  Remote-Addr
1          1              IPv4         Single-Hop Up
00:05:01  10.1.1.1/32
Number of Sessions: 2
```

---

R1#show bfd session detail

```
=====

Session Interface Index : 4          Session Index : 18
Lower Layer : IPv4                Version : 1
Session Type : Single Hop         Session State : Up

Local Discriminator : 18           Local Address : 3.3.3.1/32
Remote Discriminator : 14          Remote Address : 3.3.3.2/32
Local Port : 49169                Remote Port : 3784
Options :

Diagnostics : None

Timers in Milliseconds :
Min Tx: 1000          Min Rx: 1000          Multiplier: 2
Neg Tx: 1000          Neg Rx: 1000          Neg detect mult: 5
Min echo Tx: 20       Min echo Rx: 10       Neg echo intrvl: 0
Storage type : 2
Sess down time : 00:00:00
Sess discontinue time : 00:00:00
Bfd GTSM Disabled
Bfd Authentication Disabled

Counters values:
Pkt In : 00000000000000702        Pkt Out : 00000000000000704
Echo Out : 00000000000000000      IPv6 Echo Out : 00000000000000000
IPv6 Pkt In : 00000000000000000    IPv6 Pkt Out : 00000000000000000
UP Count : 1                       UPTIME : 00:01:37

Protocol Client Info:
RIP-> Client ID: 2          Flags: 4
=====
```



# CHAPTER 3    BFD Static Route Configuration

This chapter describes the configurations for BFD static routes.

In order to establish alternate paths to destinations that have the least possible delay it is important to quickly detect any changes to static route validity. BFD detects the liveness of a static route's nexthop and then uses the nexthop's reachability information to determine whether routes are valid. Using BFD to reach a static route's nexthop also ensures that a static route is inserted in the forwarding database only when the nexthop neighbor is reachable.

## Topology

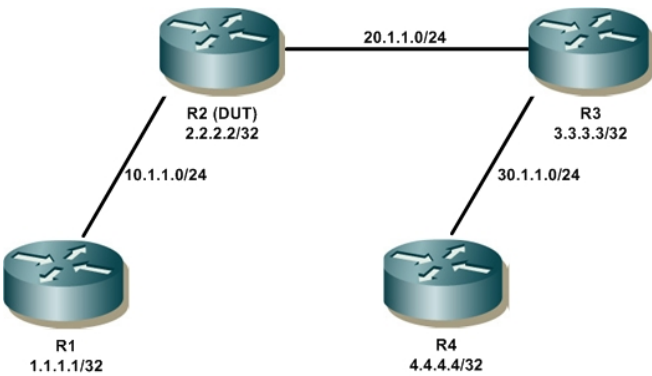


Figure 3-1: BFD Static Route Basic Topology

### Configuration for R2

R2#configure terminal	Enter the Configure mode.
R2(config)#ip route 30.1.1.0/24 20.1.1.3	Configure static route.
R2(config)#ip bfd static all-interfaces	Enable BFD for all static routes.
R2(config)#interface eth1	Enter the Interface configuration mode for eth1.
R2(config-if)#ip static bfd	Enable static BFD on the interface.
R2(config-if)#exit	Exit the Interface configuration mode.
R2(config)#ip static 30.1.1.0/24 20.1.1.3 fall-over bfd	Enable static BFD at static route level.

### Configuration for R3

R3#configure terminal	Enter the Configure mode.
R3(config)#ip route 10.1.1.0/24 20.1.1.2	Configure static route.
R3(config)#ip bfd static all-interfaces	Enable BFD for all static routes.
R3(config)#int eth1	Enter the Interface configuration mode for eth1.
R3(config-if)#ip static bfd	Enable static BFD at interface level.

---

R3(config-if)#exit	Exit the Interface configuration mode.
R3(config)#ip static 20.1.1.0/24 10.1.1.2 fall-over bfd	Enable static BFD at static route level.

---

### Verification and Validation

Enter the commands listed in the following section to confirm the configurations.

### Verify Traffic Class Groups Configuration

#### Show IP Route

##### R2#show ip route

```
Codes: K - kernel, C - connected, S - static, R - RIP, B - BGP
       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
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default

Gateway of last resort is 10.1.2.1 to network 0.0.0.0
K*      0.0.0.0/0 via 10.1.2.1, eth0
C       10.1.2.0/24 is directly connected, eth0
C       127.0.0.0/8 is directly connected, lo
K       169.254.0.0/16 is directly connected, eth0
R2#
```

#### Show BFD Session Detail

##### R2#show bfd session detail

```
-----
Session Interface Index: 5      Session Index: 1
Lower Layer:  IPv4      Version: 1      Session Type: Single Hop
Session State: Up
Local Discriminator: 1 Remote Discriminator: 1
Local Address: 20.1.1.2/32      Remote Address: 20.1.1.3/32
Local Port: 49152      Remote Port: 3784
Options:
Diagnostics: None
Timers in Milliseconds
Min Tx: 20  Min Rx: 20  Multiplier: 5
Min echo Tx: 20  Min echo Rx: 10  Neg Tx: 20
Neg echo intrvl: 0      Neg detect mult: 5
Storage type: 2
Last sess down time: 00:00:00
Sess discontinue time: 00:00:00
Counters values:
Pkt In 00000000000007675 Pkt Out 00000000000007612
Echo Out 0000000000000000
IPv6 Pkt In 0000000000000000 IPv6 Pkt Out 0000000000000000
IPv6 Echo Out 0000000000000000
UP Count: 1  UPTIME: 00:09:37
NSM-> Client ID: 1 Flags: 4
Number of Sessions: 1
```



# CHAPTER 4    BFD for MPLS LSPs

---

This chapter provides the BFD configuration information for Multi-Protocol Label Switched (MPLS) Label Switched Paths (LSPs).

---

## Overview

BFD tracks the liveness of an MPLS LSP, such as detecting a data plane failure in the forwarding path of an MPLS LSP. If MPLS LSP fails to deliver data traffic, BFD detects the failure using the control plane. An example of this issue is if the dataplane is incorrectly forwarding or dropping packets even when the control plane is functional. In this example, BFD detects the dataplane failure in the forwarding path of the MPLS LSP.

LSP ping helps detect MPLS LSP data plane failures and verifies the dataplane against the control plane. Verification occurs only if you map the LSP to the same Forwarding Equivalence Class (FEC) at both the ingress and the egress. LSP ping has extensive control plane verification features, whereas BFD only tests the dataplane BFD. This makes it more suitable for implementation in both system hardware and firmware.

Note:    Basic OSPF configuration is required for MPLS LSPs, but not for static LSPs.

---

## Configure BFD for LDP LSP

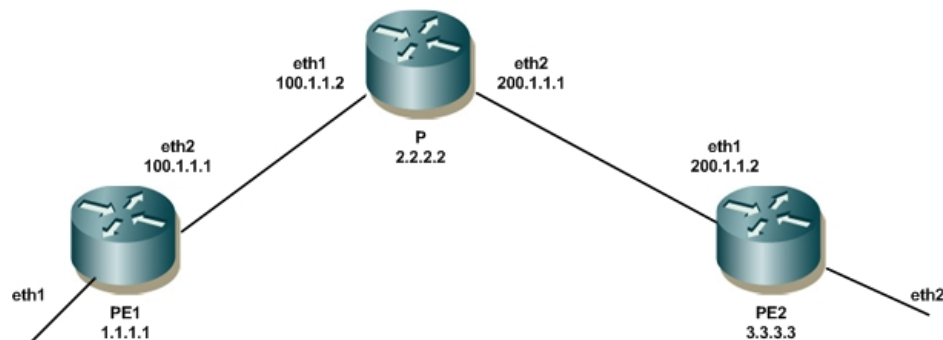


Figure 4-1: BFD for LDP LSP

### Configuration for PE1

PE-1#configure terminal	Enter the Configure mode.
PE-1(config)#router ldp	Enter the Router LDP mode.
PE-1(config-router)#targeted-peer ipv4 3.3.3.3	Configure targeted LDP session to PE2 loopback address.
PE-1(config-router-targeted-peer)#exit	Exit the Router LDP mode and return to Configure mode.
PE-1(config)#interface eth2	Enter the Interface mode for eth2.
PE-1(config-if)#label-switching	Configure label-switching on provider interface of PE1.
PE-1(config-if)#enable-ldp ipv4	Enable LDP on the provider interface of PE1.
PE-1(config-if)#exit	Exit the Interface mode and return to Configure mode.

PE-1(config)#mpls bfd ldp all force-explicit-null lsp-ping-intvl 10 min-rx 300 min-tx 300 multiplier 2	Configure BFD session for all the LDP FEC entries. Note: BFD can be enabled for particular FEC.PE-1
PE-1(config)#mpls bfd ldp all lsp-ping-intvl 10 min-rx 300 min-tx 300 multiplier 2	Configure BFD session for all the LDP FEC entries. Note: If explicit-null is enabled on egress router, then force-explicit-null should not be configured in MPLS BFD configuration.

## Configuration for P

P#configure terminal	Enter the Configure mode.
P(config)#router ldp	Enter the Router LDP mode.
P(config-router)#exit	Exit the Router LDP mode and return to Configure mode.
P(config)#interface eth1	Enter the Interface mode.
P(config-if)#label-switching	Configure label-switching.
P(config-if)#enable-ldp ipv4	Enable LDP.
PP(config-if)#exit	Exit the Interface mode and return to Configure mode.
P(config)#interface eth2	Enter the Interface mode for eth2.
P(config-if)#label-switching	Configure label-switching.
P(config-if)#enable-ldp ipv4	Enable LDP.
P(config-if)#exit	Exit the Interface mode and return to Configure mode.
P(config)#exit	Exit the Configure mode.

## Configuration for PE2

PE2#configure terminal	Enter the Configure mode.
PE2(config)#router ldp	Enter the Router LDP mode.
PE2(config-router)#targeted-peer ipv4 1.1.1.1	Configure targeted LDP session to PE2 loopback address.
PE2(config-router-targeted-peer)#exit	Exit the Router LDP mode and return to Configure mode.
PE2(config)#interface eth1	Enter the Interface mode for eth1.
PE2(config-if)#label-switching	Configure label-switching on provider interface of PE2.
PE2(config-if)#enable-ldp ipv4	Enable LDP on the provider interface of PE2.
PE2(config-if)#exit	Exit the Interface mode and return to Configure mode.

## Configure BFD for RSVP LSP

Note: RSVP commands are not supported for ZebIC releases.

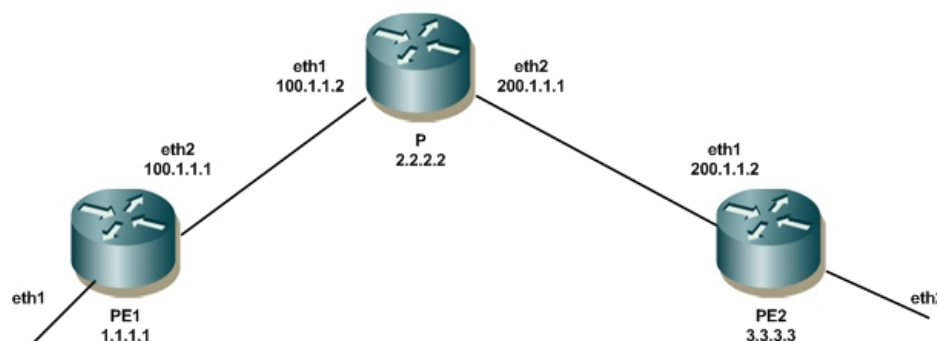


Figure 4-2: BFD for RSVP LSP Topology

### Configuration for PE1

PE1#configure terminal	Enter the Configure mode.
PE1(config)#mpls class-type ct0 default	Configure default class type.
PE1(config)#mpls te-class te0 default 0	Configure default te-class for te0.
PE1(config)#mpls te-class te1 default 1	Configure default te-class for te1.
PE1(config)#mpls te-class te2 default 2	Configure default te-class for te2.
PE1(config)#mpls te-class te3 default 3	Configure default te-class for te3.
PE1(config)#mpls te-class te4 default 4	Configure default te-class for te4.
PE1(config)#mpls te-class te5 default 5	Configure default te-class for te5.
PE1(config)#mpls te-class te6 default 6	Configure default te-class for te6.
PE1(config)#mpls te-class te7 default 7	Configure default te-class for te7.
PE1(config)#router rsvp	Enter the Router RSVP mode.
PE1(config-router)#exit	Exit the Router RSVP mode and return to Configure mode.
PE1(config)#interface eth2	Enter the Interface mode for eth2.
PE1(config-if)#label-switching	Configure label-switching on the interface.
PE1(config-if)#bandwidth 100m	Configure bandwidth on the interface.
PE1(config-if)#reservable-bandwidth 100m	Configure reservable bandwidth on the interface.
PE1(config-if)#enable-rsvp	Enable RSVP on the interface.
PE1(config-if)#exit	Exit the Interface mode and return to Configure mode.
PE1(config)#rsvp-trunk t1 ipv4	Configure RSVP trunk.
PE1(config-trunk)#to 3.3.3.3	Configure egress router address in RSVP trunk.
PE1(config)#mpls bfd rsvp mpls bfd rsvp tunnel-name t1 force-explicit-null lsp-ping- intvl 10 min-rx 300 min-tx 300 multiplier 2	Configure BFD session for RSVP trunk t1.
PE1(config)#mpls bfd rsvp mpls bfd rsvp tunnel-name t1 lsp-ping-intvl 10 min-rx 300 min-tx 300 multiplier 2	Configure BFD session for RSVP trunk t1. Note: If explicit-null is enabled on egress router then, force-explicit-null should not be configured in MPLS BFD configuration.

**Configuration for P**

P#configure terminal	Enter the Configure mode.
P(config)#mpls class-type ct0 default	Configure default class type.
P(config)#mpls te-class te0 default 0	Configure default te-class for te0.
P(config)#mpls te-class te1 default 1	Configure default te-class for te1.
P(config)#mpls te-class te2 default 2	Configure default te-class for te2.
P(config)#mpls te-class te3 default 3	Configure default te-class for te3.
P(config)#mpls te-class te4 default 4	Configure default te-class for te4.
P(config)#mpls te-class te5 default 5	Configure default te-class for te5.
P(config)#mpls te-class te6 default 6	Configure default te-class for te6.
P(config)#mpls te-class te7 default 7	Configure default te-class for te7.
P(config)#router rsvp	Enter the Router RSVP mode.
P(config-router)#exit	Exit the Router RSVP mode and return to Configure mode.
P(config)#interface eth1	Enter the Interface mode for eth1.
P(config-if)#label-switching	Configure label-switching on the interface.
P(config-if)#bandwidth 100m	Configure bandwidth on the interface.
P(config-if)#reservable-bandwidth 100m	Configure reservable bandwidth on the interface.
P(config-if)#enable-rsvp	Enable RSVP on the interface.
P(config-if)#exit	Exit the Interface mode and return to Configure mode.
P(config)#interface eth2	Enter the Interface mode for eth2.
P(config-if)#label-switching	Configure label-switching on the interface.
P(config-if)#bandwidth 100m	Configure bandwidth on the interface.
P(config-if)#reservable-bandwidth 100m	Configure reservable bandwidth on the interface.
P(config-if)#enable-rsvp	Enable RSVP on the interface.
P(config-if)#exit	Exit the Interface mode and return to Configure mode.
P(config)#exit	Exit the Configure mode.

**Configuration for PE2**

PE2#configure terminal	Enter the Configure mode.
PE2(config)#mpls class-type ct0 default	Configure default class type.
PE2(config)#mpls te-class te0 default 0	Configure default te-class for te0.
PE2(config)#mpls te-class te1 default 1	Configure default te-class for te1.
PE2(config)#mpls te-class te2 default 2	Configure default te-class for te2.
PE2(config)#mpls te-class te3 default 3	Configure default te-class for te3.
PE2(config)#mpls te-class te4 default 4	Configure default te-class for te4.
PE2(config)#mpls te-class te5 default 5	Configure default te-class for te5.
PE2(config)#mpls te-class te6 default 6	Configure default te-class for te6.
PE2(config)#mpls te-class te7 default 7	Configure default te-class for te7.
PE2(config)#router rsvp	Enter the Router RSVP mode.

PE2(config-router)#exit	Exit the Router RSVP mode and return to Configure mode.
PE2(config)#interface eth1	Enter the Interface mode for eth1.
PE2(config-if)#label-switching	Configure label-switching on the interface.
PE2(config-if)#bandwidth 100m	Configure bandwidth on the interface.
PE2(config-if)#reservable-bandwidth 100m	Configure reservable bandwidth on the interface.
PE2(config-if)#enable-rsvp	Enable RSVP on the interface.
PE2(config-if)#exit	Exit the Interface mode and return to Configure mode.

## Validation

Enter the following commands:

- show bfd session
- show bfd session detail
- show mpls forwarding-table

## Verify BFD Session for RSVP LSP

PE1#show mpls forwarding-table

Codes: > - selected FTN, p - stale FTN, B - BGP FTN, K - CLI FTN, L - LDP FTN,  
R - RSVP-TE FTN, S - SNMP FTN, I - IGP-Shortcut, U - unknown FTN

Code	FEC	Tunnel-id	FTN-ID	Pri	Nexthop	Out-Label	Out-Intf	LSP-Type
L>	2.2.2.2/32	0	1	Yes	100.1.1.2	3	eth2	LSP_DEFAULT
R>	3.3.3.3/32	101	4	Yes	100.1.1.2	53760	eth2	LSP_DEFAULT
L	3.3.3.3/32	0	2	Yes	100.1.1.2	53121	eth2	LSP_DEFAULT
L>	200.1.1.0/24	0	3	Yes	100.1.1.2	3	eth2	LSP_DEFAULT

PE1#show bfd session

```

Session Interface Index : 3      Session Index: 2
Lower Layer:  MPLS LSP   Single Hop
Session State : Up
Local Discriminator: 2 Remote Discriminator: 2
LSP Owner:  RSVP FTN Ix: 4      Tunnel Name: t1
LSP Ping Interval in seconds: 10
Local Address : 1.1.1.1/32      Remote Address: 127.0.0.12/32
Local Port : 49153      Remote Port: 3784
Timers in Milliseconds
Min Tx: 300  Min Rx: 300  Multiplier: 2
UP Count: 0  UPTIME: 00:00:00
Bfd GTSM Disabled
Number of Sessions:    1

```

PE1#show bfd session detail

```

-----
Session Interface Index : 3      Session Index: 2
Lower Layer:  MPLS LSP   Version : 1  Session Type: Single Hop
Session State : Up
Local Discriminator : 2 Remote Discriminator: 2
LSP Owner:  RSVP FTN Ix: 4      Tunnel Name: t1
LSP Ping Interval in seconds: 10

```

```
Local Address : 1.1.1.1/32      Remote Address: 127.0.0.12/32
Local Port : 49153      Remote Port: 3784
Options :
Diagnostics: None
Timers in Milliseconds
Min Tx: 300  Min Rx: 300  Multiplier: 2
Min echo Tx: 0  Min echo Rx: 0  Neg Tx: 300
Neg echo intrvl: 0      Neg detect mult: 5
Storage type: 2
Sess down time: 00:00:00
Sess discontinue time: 00:00:00
Counters values:
Pkt In 0000000000000012 Pkt Out 0000000000000000
Echo Out 0000000000000000
IPv6 Pkt In 0000000000000000 IPv6 Pkt Out 0000000000000000
IPv6 Echo Out 0000000000000000
UP Count: 1  UPTIME: 00:00:07
NSM-> Client ID: 1 Flags: 4
Number of Sessions: 1
```

Configure BFD for Static LSP

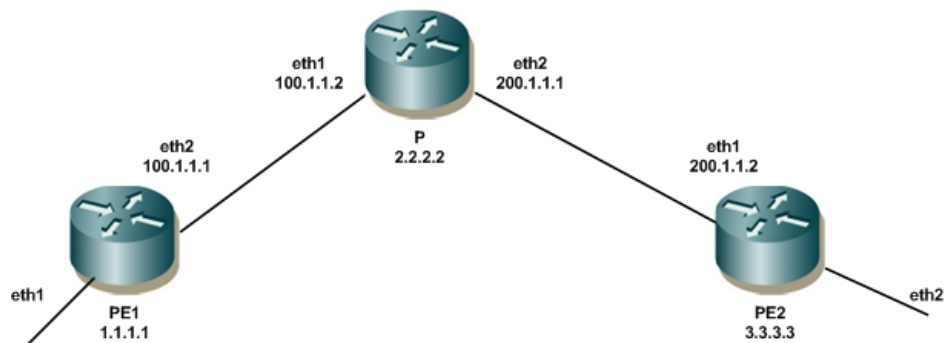


Figure 4-3: BFD for Static LSP Topology

Configuration for PE1

PE1#configure terminal	Enter the Configure mode.
PE1(config)#mpls ftn-entry tunnel-id 11 3.3.3.3/32 100 100.1.1.2 eth2 primary	Configure MPLS FTN entry for static LSP.
PE1(config)#mpls bfd static 3.3.3.3/32 force-explicit-null lsp-ping-intvl 10 min-rx 300 min-tx 300 multiplier 2	Configures BFD session for static LSP.
PE1(config)#exit	Exit the Configure mode.

## Configuration on Router P

PE1#configure terminal	Enter the Configure mode.
PE1(config)#mpls ilm-entry 100 eth1 swap 3 eth2 200.1.1.2 3.3.3.3/32	Configure MPLS FTN entry for static LSP.
PE1(config)#exit	Exit the Configure mode.

## Validation

Enter the following commands:

- show bfd session
- show bfd session detail
- show mpls forwarding-table

## Verify BFD Session for LDP LSP

PE1#show mpls forwarding-table

Codes: > - selected FTN, p - stale FTN, B - BGP FTN, K - CLI FTN, L - LDP FTN,  
R - RSVP-TE FTN, S - SNMP FTN, I - IGP-Shortcut, U - unknown FTN

Code	FEC	Tunnel-id	FTN-ID	Pri	Nexthop	Out-Label	Out-Intf	LSP-Type
L>	2.2.2.2/32	0	1	Yes	100.1.1.2	3	eth2	LSP_DEFAULT
L>	3.3.3.3/32	0	2	Yes	100.1.1.2	53121	eth2	LSP_DEFAULT
L>	200.1.1.0/24	0	3	Yes	100.1.1.2	3	eth2	LSP_DEFAULT

PE1#show bfd session

```

Session Interface Index: 3      Session Index: 1
Lower Layer:  MPLS LSP   Single Hop
Session State: Up
Local Discriminator: 1 Remote Discriminator: 1
LSP Owner: LDP  FTN Ix: 2      FEC: 3.3.3.3/32
LSP Ping Interval in seconds: 10
Local Address: 1.1.1.1/32      Remote Address: 127.0.0.12/32
Local Port: 49152      Remote Port: 3784
Timers in Milliseconds
Min Tx: 300  Min Rx: 300  Multiplier: 2
UP Count: 1  UPTIME: 00:00:22
Bfd GTSM Disabled
Number of Sessions:      1

```

PE1#show bfd session detail

```

-----
Session Interface Index: 3      Session Index: 1
Lower Layer:  MPLS LSP   Version: 1  Session Type: Single Hop
Session State: Up
Local Discriminator: 1 Remote Discriminator: 1
LSP Owner: LDP  FTN Ix: 2      FEC: 3.3.3.3/32
LSP Ping Interval in seconds: 10
Local Address: 1.1.1.1/32      Remote Address: 127.0.0.12/32
Local Port: 49152      Remote Port: 3784
Options:

```

Diagnostics: None  
Timers in Milliseconds  
Min Tx: 300 Min Rx: 300 Multiplier: 2  
Min echo Tx: 0 Min echo Rx: 0 Neg Tx: 300  
Neg echo intrvl: 0 Neg detect mult: 5  
Storage type: 2  
Sess down time: 00:00:00  
Sess discontinue time: 00:00:00  
Counters values:  
Pkt In 0000000000000005d Pkt Out 0000000000000000  
Echo Out 0000000000000000  
IPv6 Pkt In 0000000000000000 IPv6 Pkt Out 0000000000000000  
IPv6 Echo Out 0000000000000000  
UP Count: 1 UPTIME: 00:00:25  
NSM-> Client ID: 1 Flags: 4  
Number of Sessions: 1

## Configure BFD for Static LSP with Explicit Null

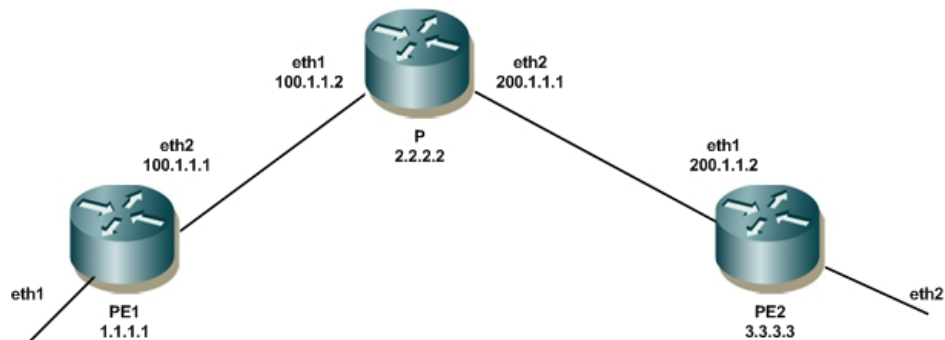


Figure 4-4: Static LSP BFD with Explicit Null

### Configuration for PE1

PE1#configure terminal	Enter the Configure mode.
PE1(config)#mpls ftn-entry tunnel-id 11 3.3.3.3/32 100 100.1.1.2 eth2 primary	Configure MPLS FTN entry for static LSP.
PE1(config)#mpls bfd static 3.3.3.3/32 lsp-ping-intvl 10 min-rx 300 min-tx 300 multiplier 2	Configures BFD session for static LSP.
PE1(config)#exit	Exit the Configure mode.

### Configuration for P

P#configure terminal	Enter the Configure mode.
P(config)#mpls ilm-entry 100 eth1 swap 0 eth2 200.1.1.2 3.3.3.3/32	Configure MPLS ILM entry for static LSP.
P(config)#exit	Exit the Configure mode.



## Validation

Enter the following commands:

- show bfd session
- show bfd session detail
- show mpls forwarding-table

## Verify BFD Session for Static LSP

PE1#show mpls forwarding-table

Codes: > - selected FTN, p - stale FTN, B - BGP FTN, K - CLI FTN, L - LDP FTN,  
R - RSVP-TE FTN, S - SNMP FTN, I - IGP-Shortcut, U - unknown FTN

Code	FEC	Tunnel-id	FTN-ID	Pri	Nexthop	Out-Label	Out-Intf	LSP-Type
L>	2.2.2.2/32	0	1	Yes	100.1.1.2	3	eth2	LSP_DEFAULT
K>	3.3.3.3/32	11	5	Yes	100.1.1.2	100	eth2	LSP_DEFAULT
R	3.3.3.3/32	101	4	Yes	100.1.1.2	53760	eth2	LSP_DEFAULT
L	3.3.3.3/32	0	2	Yes	100.1.1.2	53121	eth2	LSP_DEFAULT
L>	200.1.1.0/24	0	3	Yes	100.1.1.2	3	eth2	LSP_DEFAULT

PE1#show bfd session

```

Session Interface Index : 3      Session Index: 3
Lower Layer:  MPLS LSP   Single Hop
Session State : Up
Local Discriminator : 3 Remote Discriminator: 3
LSP Owner: Static      FTN Ix: 5      FEC: 3.3.3.3/32
LSP Ping Interval in seconds: 10
Local Address : 1.1.1.1/32      Remote Address: 127.0.0.12/32
Local Port : 49154      Remote Port: 3784
Timers in Milliseconds
Min Tx: 300  Min Rx: 300  Multiplier: 2
UP Count: 1  UPTIME: 00:00:37
Bfd GTSM Disabled
Number of Sessions:      1

```

PE1#show bfd session detail

```

-----
Session Interface Index : 3      Session Index: 3
Lower Layer:  MPLS LSP   Version : 1  Session Type: Single Hop
Session State : Up
Local Discriminator : 3 Remote Discriminator: 3
LSP Owner: Static      FTN Ix: 5      FEC: 3.3.3.3/32
LSP Ping Interval in seconds: 10
Local Address : 1.1.1.1/32      Remote Address: 127.0.0.12/32
Local Port : 49154      Remote Port: 3784
Options :
Diagnostics: None
Timers in Milliseconds
Min Tx: 300  Min Rx: 300  Multiplier: 2
Min echo Tx: 0  Min echo Rx: 0  Neg Tx: 300
Neg echo intrvl: 0      Neg detect mult: 5

```

```
Storage type: 2
Sess down time: 00:00:00
Sess discontinue time: 00:00:00
Counters values:
Pkt In 0000000000000095 Pkt Out 0000000000000000
Echo Out 0000000000000000
IPv6 Pkt In 0000000000000000 IPv6 Pkt Out 0000000000000000
IPv6 Echo Out 0000000000000000
UP Count: 1 UPTIME: 00:00:42
NSM-> Client ID: 1 Flags: 4
Number of Sessions: 1
wqa12#
```

---

## Disable BFD for MPLS LSP

### Configuration for PE1

PE1#configure terminal	Enter the Configure mode.
PE1(config)#mpls bfd static 3.3.3.3/32 disable	Disable BFD for static LSP.
PE1(config)#mpls bfd rsvp tunnel-name t1 disable	Disable BFD for RSVP LSP.
PE1(config)#mpls bfd ldp 3.3.3.3/32 disable	Disable BFD for LDP LSP.
PE1(config)#exit	Exit the Configure mode.

---

## Remove BFD for MPLS LSP

Referring to the same basic topology, follow the steps in the table below to remove BFD for MPLS LSP.

### Configuration for PE1

PE1#configure terminal	Enter the Configure mode.
PE1(config)#no mpls bfd static all	Unconfigure BFD for all Static LSPs.
PE1(config)#no mpls bfd ldp all	Unconfigure BFD for all LDP LSPs.
PE1(config)#no mpls bfd rsvp all	Unconfigure BFD for all RSVP LSPs.
PE1(config)#exit	Exit the Configure mode.

## CHAPTER 5 BFD Authentication

---

This chapter provides BFD authentication configuration examples.

---

### Overview

Bidirectional Forwarding Detection (BFD) is a protocol intended to detect faults in the bidirectional path between two forwarding engines, including physical interfaces, sub-interfaces, and data link. It operates independently of media, data protocols, and routing protocols. A session will be created between links. When BFD links is hacked, the link may be falsely declared to be down, or falsely declared to be up. To overcome this type of situations, need to use authentication on BFD. Using this we can mitigate threats from attackers.

ZebOS-XP supports the following authentication types:

- Simple password
- Keyed/Meticulous MD5
- Keyed/Meticulous SHA1

Among these types, meticulous SHA1 is the strongest one.

Authentication is optionally enabled on BFD sessions. By default, it is disabled and is configurable via CLI. When authentication is enabled, BFD packets will exchange with authentication section (based on the configured auth type). Receiving system will examine the authentication section of the packet; if it is successful then it will accept. Otherwise, it will discard.

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### Enabling BFD Authentication

On a Router BFD authentication can be enabled for multiple keys & or single key support over a BFD sessions:

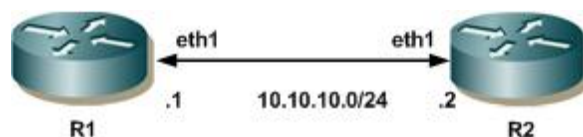
- Using Key-chain, for multiple key support
- Using Key-ID, for single key support

ZebOS-XP supports BFD Authentication for IPv4 & IPv6, with single-hop & multihop. Enabling BFD Authentication for Single-hop for IPv4, using key chain. In this example, the BFD session is configured between R1 & R2 using multiple key (using key chain).

Once the BFD session is up, the authentication is enabled on both the routers, with the authentication type as simple password. We can enable the authentication on BFD session using any one of the above-mentioned authentication type, with the identical authentication Type on both side. Steps for configuring BFD authentication for IPv6 are mentioned along with the configuration steps for IPv4.

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### Topology



**Figure 5-1: Basic Topology of Two Routers**

**Router 1 (R1)**

R1#configure terminal	Enter the Configure mode.
R1 (config)#key chain IPInfusion	Configure the key chain by assigning the string to it.
R1 (config-keychain)#key 14	Configure key-ID for the key chain. Multiple keys can be configured for same key chain but only one will be used for authentication.
R1 (config-keychain-key)#key-string R1	Assign the key-string to the key.
R1 (config-keychain)#key 15	Configure the key-ID for the key chain.
R1 (config-keychain-key)#key-string IPI-ZebOS	Assign the key-string to the key.
R1 (config-keychain-key)#exit	Exit from the Key mode.
R1 (config-keychain)#exit	Exit from the Key Chain mode.
R1 (config)#interface eth1	Enter the Interface configuration mode.
R1 (config-if)#bfd session 10.10.10.1 10.10.10.2	Enable the BFD session between peers. Note: For IPv6, provide the IPv6 source and destination addresses for the BFD session.
R1 (config-if)#bfd auth type simple key-chain IP Infusion	Enable the Authentication for BFD as Type-simple password. Note: Configure authentication type as any one of mentioned types.
R1 (config-if)#end	Exit the Interface mode.

**Router 2 (R2)**

R2#configure terminal	Enter the Configure mode.
R2 (config)#key chain IPInfusion	Configure the key chain by assigning the string to it.
R2 (config-keychain)#key 14	Configure key-ID for the key chain. Multiple keys can be configured for same key chain but only one will be used for authentication.
R2 (config-keychain-key)#key-string R2	Assign the key-string to the key.
R2 (config-keychain)#key 15	Configure the key-ID for the key chain.
R2 (config-keychain-key)#key-string IPI-ZebOS	Assign the key-string to the key.
R2 (config-keychain-key)#exit	Exit from the Key mode.
R2 (config-keychain)#exit	Exit from the Key Chain mode.
R2R2 (config)#interface eth1	Enter the Interface configuration mode.
R2 (config-if)#bfd session 10.10.10.2 10.10.10.1	Enable the BFD session between peers. Note: For IPv6, provide the IPv6 source and destination addresses for the BFD session.
R2 (config-if)#bfd auth type simple key-chain IP Infusion	Enable the Authentication for BFD as Type-simple password. Note: Configure authentication type as any one of mentioned types.
R2 (config-if)#end	Exit the Interface mode.

**Validation**

Check for Session to be single-hop, up with the remote address as of R2 in “show bfd session” & in “show bfd session detail”, check for BFD authentication is enabled with authentication type- configured.

R1#show bfd session

Sess-Idx	Remote-Disc	Lower-Layer	Sess-Type	Sess-State	UP-Time	Remote-Addr
1	1	IPv4	Single-Hop	Up	00:00:20	10.10.10.2/32

Number of Sessions: 1

R1#sh bfd session detail

=====

Session Interface Index : 3	Session Index : 1
Lower Layer : IPv4	Version : 1
Session Type : Single Hop	Session State : Up
Local Discriminator : 1	Local Address : 10.10.10.1/32
Remote Discriminator : 1	Remote Address : 10.10.10.2/32
Local Port : 49152	Remote Port : 3784
Options :	

Diagnostics : None

Timers in Milliseconds :

Min Tx: 20	Min Rx: 20	Multiplier: 5
Neg Tx: 20	Neg Rx: 1000	Neg detect mult: 5
Min echo Tx: 20	Min echo Rx: 10	Neg echo intrvl: 0

Storage type : 2

Sess down time : 00:00:00

Sess discontinue time : 00:00:00

Bfd GTSM Disabled

Bfd Authentication Enabled

Authentication type : simple

Authentication Key-id : 14

Counters values:

Pkt In : 00000000000003bd	Pkt Out : 000000000000042c
Echo Out : 0000000000000000	IPv6 Echo Out : 0000000000000000
IPv6 Pkt In : 0000000000000000	IPv6 Pkt Out : 0000000000000000
UP Count : 1	UPTIME : 00:00:22

Protocol Client Info:

BFD-> Client ID: 28      Flags: 4

-----

Number of Sessions: 1

R2#sh bfd session

Sess-Idx	Remote-Disc	Lower-Layer	Sess-Type	Sess-State	UP-Time	Remote-Addr
1	1	IPv4	Single-Hop	Up	00:00:09	10.10.10.1/32

Number of Sessions: 1

R2#sh bfd session detail

=====

Session Interface Index : 3	Session Index : 1
Lower Layer : IPv4	Version : 1
Session Type : Single Hop	Session State : Up
Local Discriminator : 1	Local Address : 10.10.10.2/32
Remote Discriminator : 1	Remote Address : 10.10.10.1/32

## BFD Authentication

---

Local Port : 49152

Remote Port : 3784

Options :

Diagnostics : None

Timers in Milliseconds :

Min Tx: 20

Min Rx: 20

Multiplier: 5

Neg Tx: 20

Neg Rx: 20

Neg detect mult: 5

Min echo Tx: 20

Min echo Rx: 10

Neg echo intrvl: 0

Storage type : 2

Sess down time : 00:00:00

Sess discontinue time : 00:00:00

Bfd GTSM Disabled

Bfd Authentication Enabled

Authentication type : simple

Authentication Key-id : 14

Counters values:

Pkt In : 000000000000020a

Pkt Out : 000000000000020e

Echo Out : 0000000000000000

IPv6 Echo Out : 0000000000000000

IPv6 Pkt In : 0000000000000000

IPv6 Pkt Out : 0000000000000000

UP Count : 1

UPTIME : 00:00:11

Protocol Client Info:

BFD-> Client ID: 28      Flags: 4

-----  
Number of Sessions:      1

## Enabling BFD Authentication for Single-hop for IPv4, Using Key-ID

In this example, the BFD session is configured between R1 and R2 using single key (using key-ID). Once the BFD session is up, the authentication is enabled on both the routers, with the authentication type as keyed-MD5. We can enable the authentication on BFD session using any one of the above mentioned authentication type, with the Identical authentication type on both side.

### Topology

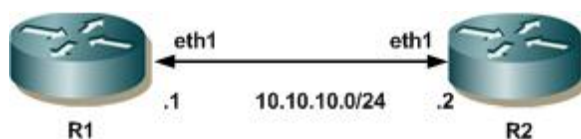


Figure 5-2: Basic Topology of Two Routers

#### Router 1 (R1)

R1#configure terminal	Enter the Configure mode.
R1(config)#interface eth1	Enter the Interface configuration mode.
R1(config-if)#bfd session 10.10.10.1 10.10.10.2	Enable the BFD session between peers. Note: For IPv6, provide the IPv6 source and destination addresses for the BFD session.
R1(config-if)#bfd auth type keyed-md5 key-id 10 key ZebOS	Enable the Authentication for BFD as Type keyed-MD5. Note: Configure authentication type as any one of mentioned types.
R1(config-if)#end	Exit the Interface mode.

#### Router 2 (R2)

R2#configure terminal	Enter the Configure mode.
R2(config)#interface eth1	Enter the Interface configuration mode.
R2(config-if)#bfd session 10.10.10.2 10.10.10.1	Enable the BFD session between peers. Note: For IPv6, provide the IPv6 source and destination addresses for the BFD session.
R2(config-if)#bfd auth type keyed-md5 key-id 10 key ZebOS	Enable the Authentication for BFD as Type keyed-MD5. Note: Configure authentication type as any one of mentioned types.
R2(config-if)#end	Exit the Interface mode.

## Validation

Check for Session to be single-hop, up with the remote address as of R2 in “show bfd session” & in “show bfd session detail”, check for BFD authentication is enabled with authentication type- configured.

```
R1#show bfd session
Sess-Idx  Remote-Disc  Lower-Layer  Sess-Type  Sess-State  UP-Time  Remote-
Addr
1          1              IPv4         Single-Hop  Up          00:00:40
10.10.10.2/32
Number of Sessions: 1
R1#sh bfd session detail
=====

Session Interface Index : 3          Session Index : 1
Lower Layer : IPv4                 Version : 1
Session Type : Single Hop          Session State : Up
Local Discriminator : 1             Local Address : 10.10.10.1/32
Remote Discriminator : 1            Remote Address : 10.10.10.2/32
Local Port : 49152                  Remote Port : 3784
Options :

Diagnostics : None

Timers in Milliseconds :
Min Tx: 20                        Min Rx: 20                        Multiplier: 5
Neg Tx: 20                        Neg Rx: 20                        Neg detect mult: 5
Min echo Tx: 20                   Min echo Rx: 10                   Neg echo intrvl: 0
Storage type : 2
Sess down time : 00:00:00
Sess discontinue time : 00:00:00
Bfd GTSM Disabled
Bfd Authentication Enabled
Authentication type : keyed-md5
Authentication Key-id : 10

Counters values:
Pkt In : 00000000000002a97         Pkt Out : 00000000000002b15
Echo Out : 00000000000000000       IPv6 Echo Out : 00000000000000000
IPv6 Pkt In : 00000000000000000     IPv6 Pkt Out : 00000000000000000
UP Count : 2                        UPTIME : 00:00:42

Protocol Client Info:
BFD-> Client ID: 28                Flags: 4
-----
Number of Sessions: 1

R2#show bfd session
Sess-Idx  Remote-Disc  Lower-Layer  Sess-Type  Sess-State  UP-Time  Remote-
Addr
1          1              IPv4         Single-Hop  Up          00:00:04
10.10.10.1/32
Number of Sessions: 1
R2#sh bfd session detail
=====

Session Interface Index : 3          Session Index : 1
Lower Layer : IPv4                 Version : 1
```



```

Session Type : Single Hop
Local Discriminator : 1
Remote Discriminator : 1
Local Port : 49152
Options :
Session State : Up
Local Address : 10.10.10.2/32
Remote Address : 10.10.10.1/32
Remote Port : 3784

```

```
Diagnostics : None
```

```
Timers in Milliseconds :
```

```

Min Tx: 20           Min Rx: 20           Multiplier: 5
Neg Tx: 20           Neg Rx: 1000          Neg detect mult: 5
Min echo Tx: 20      Min echo Rx: 10       Neg echo intrvl: 0
Storage type : 2

```

```

Sess down time : 00:00:00
Sess discontinue time : 00:00:00
Bfd GTSM Disabled
Bfd Authentication Enabled
Authentication type : keyed-md5
Authentication Key-id : 10

```

```
Counters values:
```

```

Pkt In : 0000000000000236b      Pkt Out : 00000000000002373
Echo Out : 00000000000000000    IPv6 Echo Out : 00000000000000000
IPv6 Pkt In : 00000000000000000  IPv6 Pkt Out : 00000000000000000
UP Count : 2                     UPTIME : 00:00:07

```

```
Protocol Client Info:
```

```
BFD-> Client ID: 28      Flags: 4
```

```
-----
Number of Sessions:      1
```

## Enabling BFD Authentication for Multihop for IPv6, Using Key-chain

In this example, configure the BFD Multihop session between R1 & R3 with the network reachability between R1, R2 & R3. Configure the static route between R1-R3 & then enable the Authentication on R1 & R3 with the identical authentication type on both as mentioned as following:

- Simple Password
- Keyed-MD5
- Meticulous-keyed-MD5
- Keyed-SHA1
- Meticulous-keyed-SHA1

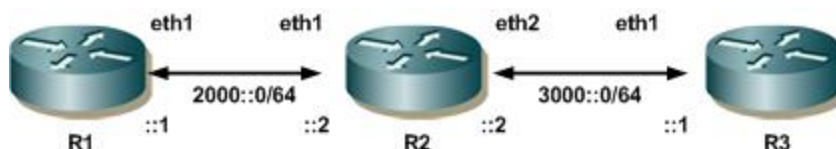


Figure 5-3: Basic Topology of Three Routers

### Router 1 (R1)

R1#configure terminal	Enter the Configure mode.
R1(config)#key chain IPInfusion	Configure the key chain by assigning the string to it.

## BFD Authentication

R1 (config-keychain)#key 14	Configure key-ID for the keychain. Multiple keys can be configured for same key chain.
R1 (config-keychain-key)#key-string R1	Assign the key-string to the key.
R1 (config-keychain)#key 15	Configure the key-ID for the keychain.
R1 (config-keychain-key)#key-string IPI-ZebOS	Assign the key-string to the key.
R1 (config-keychain-key)#exit	Exit from the Key mode.
R1 (config-keychain)#exit	Exit from the Key Chain mode.
R1 (config)#interface eth1	Enter the Interface configuration mode.
R1 (config-if)#bfd session 2000::1 3000::1 multihop	Enable the BFD multihop session between peers. Note: For IPv4, provide the IPv4 source and destination addresses for the BFD session.
R1 (config-if)#exit	Exit the interface mode.
R1 (config)#bfd multihop-peer 3000::1 auth type keyed-sha1 key-chain IPInfusion	Enable the Authentication for BFD as Type-keyed-SHA1. Note: Configure authentication type as any one of mentioned types.
R1 (config)#ipv6 route 3000::/64 2000::2	Configure the static route between the multihop BFD peers.
R1 (config)#exit	Exit the Router mode.

## Router 3 (R3)

R3#configure terminal	Enter the Configure mode.
R3 (config)#key chain IPInfusion	Configure the key chain by assigning the string to it.
R3 (config-keychain)#key 14	Configure key-ID for the keychain. Multiple keys can be configured for same key chain.
R3 (config-keychain-key)#key-string R3	Assign the key-string to the key.
R3 (config-keychain)#key 15	Configure the key-ID for the keychain.
R3 (config-keychain-key)#key-string IPI-ZebOS	Assign the key-string to the key.
R3 (config-keychain-key)#exit	Exit from the Key mode.
R3 (config-keychain)#exit	Exit from the Key Chain mode.
R3 (config)#interface eth1	Enter the Interface configuration mode.
R3 (config-if)#bfd session 3000::1 2000::1 multihop	Enable the BFD multihop session between peers. Note: For IPv4, provide the IPv4 source and destination addresses for the BFD session.
R3 (config-if)#exit	Exit the interface mode.
R3 (config)#bfd multihop-peer 2000::1 auth type keyed-sha1 key-chain IPInfusion	Enable the authentication for BFD as Type-keyed-SHA1. Note: Configure authentication type as any one of mentioned types.
R3 (config)#ipv6 route 2000::/64 3000::2	Configure the static route between the multihop BFD peers.
R3 (config)#exit	Exit the Router mode.

## Validation

Check for Session to be multi-hop, up with the remote IPv6 address as of R3 in “show bfd session” & in “show bfd session detail”, check for BFD authentication is enabled with authentication type- configured.

```
R1#show bfd session
```

Sess-Idx	Remote-Disc	Lower-Layer	Sess-Type	Sess-State	UP-Time	Remote-Addr
1	1	IPv6	Multi-Hop	Up	00:09:17	3000::1/128

Number of Sessions: 1  
DUT#sh bfd session detail

```

=====
Session Interface Index : 0          Session Index : 1
Lower Layer : IPv6                 Version : 1
Session Type : Multihop Arbit Path Session State : Up
Local Discriminator : 1             Local Address : 2000::1/128
Remote Discriminator : 1            Remote Address : 3000::1/128
Local Port : 49152                  Remote Port : 14784
Options :

```

Diagnostics : None

```

Timers in Milliseconds :
Min Tx: 20                Min Rx: 20                Multiplier: 5
Neg Tx: 20                Neg Rx: 1000           Neg detect mult: 5
Min echo Tx: 20           Min echo Rx: 10        Neg echo intrvl: 0
Storage type : 2
Sess down time : 00:00:00
Sess discontinue time : 00:00:00
Bfd GTSM Disabled
Bfd Authentication Enabled
Authentication type : keyed-sha1
Authentication Key-id : 14

```

```

Counters values:
Pkt In : 00000000000000000000    Pkt Out : 00000000000000000000
Echo Out : 00000000000000000000    IPv6 Echo Out : 00000000000000000000
IPv6 Pkt In : 000000000000096e0     IPv6 Pkt Out : 00000000000009788
UP Count : 2                        UPTIME : 00:09:19

```

Protocol Client Info:  
BFD-> Client ID: 28      Flags: 4

-----  
Number of Sessions: 1

Sess-Idx	Remote-Disc	Lower-Layer	Sess-Type	Sess-State	UP-Time	Remote-Addr
1	1	IPv6	Multi-Hop	Up	00:09:34	2000::1/128

Number of Sessions: 1  
R2#sh bfd session detail

```

=====
Session Interface Index : 0          Session Index : 1
Lower Layer : IPv6                 Version : 1
Session Type : Multihop Arbit Path Session State : Up
Local Discriminator : 1             Local Address : 3000::1/128
Remote Discriminator : 1            Remote Address : 2000::1/128
Local Port : 49152                  Remote Port : 14784
Options :

```

Diagnostics : None

Timers in Milliseconds :

Min Tx: 20	Min Rx: 20	Multiplier: 5
Neg Tx: 20	Neg Rx: 20	Neg detect mult: 5
Min echo Tx: 20	Min echo Rx: 10	Neg echo intrvl: 0
Storage type : 2		
Sess down time : 00:00:00		
Sess discontinue time : 00:00:00		
Bfd GTSM Disabled		
Bfd Authentication Enabled		
Authentication type : keyed-sha1		
Authentication Key-id : 14		

Counters values:

Pkt In : 0000000000000000	Pkt Out : 0000000000000000
Echo Out : 0000000000000000	IPv6 Echo Out : 0000000000000000
IPv6 Pkt In : 00000000000009a73	IPv6 Pkt Out : 00000000000009a7e
UP Count : 2	UPTIME : 00:09:36

Protocol Client Info:

BFD-> Client ID: 28      Flags: 4

-----  
Number of Sessions:      1

## Enabling BFD Authentication for Multihop for IPv6, Using Key-ID

In this example, configure the BFD Multihop session between R1 & R3 with the network reachability between R1, R2 & R3. Configure the static route between R1-R3 & then enable the Authentication on R1 & R3 with the identical authentication type for single BFD session (using key-ID)



Figure 5-4: Basic Topology of Three Routers

### Router 1 (R1)

R1#configure terminal	Enter the Configure mode.
R1(config)#interface eth1	Enter the Interface configuration mode.
R1(config-if)#bfd session 2000::1 3000::2 multihop	Enable the BFD multihop session between peers. Note: For IPv4, provide the IPv4 source and destination addresses for the BFD session.
R1(config-if)#exit	Exit the interface mode.
R1(config)#bfd multihop-peer 3000::2 auth type meticulous-keyed-sha1 key-id 10 key ZebOS	Enable the Authentication for BFD as Type-keyed-SHA1. Note: Configure authentication type as any one of mentioned types.
R1(config)#ipv6 route 3000::/64 2000::2	Configure the static route between the multihop BFD peers.
R1(config)#exit	Exit the Router mode.

### Router 3 (R3)

R3#configure terminal	Enter the Configure mode.
R3(config)#interface eth1	Enter the Interface configuration mode.
R3(config-if)#bfd session 3000::2 2000::1 multihop	Enable the BFD multihop session between peers. Note: For IPv4, provide the IPv4 source and destination addresses for the BFD session.
R3(config-if)#exit	Exit the interface mode.
R3(config)#bfd multihop-peer 2000::1 auth type meticulous-keyed-sha1 key-id 10 key ZebOS	Enable the Authentication for BFD as Type-keyed-SHA1. Note: Configure authentication type as any one of mentioned types.
R3(config)#ipv6 route 2000::/64 3000::1	Configure the static route between the multihop BFD peers.
R3(config)#exit	Exit the Router mode.

### Validation

Check for Session to be multi-hop, up with the remote IPv6 address as of R3 in “show bfd session” & in “show bfd session detail”, check for BFD authentication is enabled with authentication type- configured.

```
R1#show bfd session detail
```

```
=====
```

```
Session Interface Index : 0
Lower Layer : IPv6
```

```
Session Index : 1
Version : 1
```

Session Type : Multihop Arbit Path	Session State : Up
Local Discriminator : 1	Local Address : 2000::1/128
Remote Discriminator : 1	Remote Address : 3000::2/128
Local Port : 49152	Remote Port : 14784
Options :	

Diagnostics : None

Timers in Milliseconds :

Min Tx: 20	Min Rx: 20	Multiplier: 5
Neg Tx: 20	Neg Rx: 20	Neg detect mult: 5
Min echo Tx: 20	Min echo Rx: 10	Neg echo intrvl: 0

Storage type : 2

Sess down time : 00:00:00

Sess discontinue time : 00:00:00

Bfd GTSM Disabled

Bfd Authentication Enabled

Authentication type : meticulous-keyed-sha1

Authentication Key-id : 10

Counters values:

Pkt In : 0000000000000000

Pkt Out : 0000000000000000

Echo Out : 0000000000000000

IPv6 Echo Out : 0000000000000000

IPv6 Pkt In : 0000000000001c8c2

IPv6 Pkt Out : 0000000000001def6

UP Count : 8

UPTIME : 00:13:09

Protocol Client Info:

BFD-> Client ID: 28      Flags: 4

-----  
Number of Sessions:      1

**R3#show bfd session detail**

=====

Session Interface Index : 0	Session Index : 1
-----------------------------	-------------------

Lower Layer : IPv6	Version : 1
--------------------	-------------

Session Type : Multihop Arbit Path	Session State : Up
------------------------------------	--------------------

Local Discriminator : 1	Local Address : 3000::2/128
-------------------------	-----------------------------

Remote Discriminator : 1	Remote Address : 2000::1/128
--------------------------	------------------------------

Local Port : 49152	Remote Port : 14784
--------------------	---------------------

Options :

Diagnostics : None

Timers in Milliseconds :

Min Tx: 20	Min Rx: 20	Multiplier: 5
Neg Tx: 20	Neg Rx: 1000	Neg detect mult: 5
Min echo Tx: 20	Min echo Rx: 10	Neg echo intrvl: 0

Storage type : 2

Sess down time : 00:00:00

Sess discontinue time : 00:00:00

Bfd GTSM Disabled

Bfd Authentication Enabled

Authentication type : meticulous-keyed-sha1

Authentication Key-id : 10

Counters values:

Pkt In : 0000000000000000

Pkt Out : 0000000000000000

```
Echo Out : 0000000000000000
IPv6 Pkt In : 0000000000001dfce
UP Count : 8
```

```
IPv6 Echo Out : 0000000000000000
IPv6 Pkt Out : 000000000001e04b
UPTIME : 00:13:16
```

```
Protocol Client Info:
```

```
BFD-> Client ID: 28      Flags: 4
```

```
-----
Number of Sessions:      1
```

## Configuring Active Key for Enabling BFD Authentication for Multihop for IPv6, Using Key-chain

In this example, configure active key using send-lifetime, for the multiple keys configured under key chain. The active key will be selected on below mention criteria. If start of time is default value (means zero) or key start of time has started to use (configured value), then that active key will be selected from the key chain.

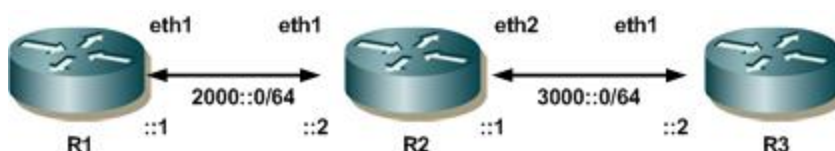


Figure 5-5: Basic Topology of Three Routers

### Router 1 (R1)

R1#configure terminal	Enter the Configure mode.
R1(config)#key chain IPInfusion	Configure the key chain by assigning the string to it.
R1(config-keychain)#key 14	Configure key-ID for the keychain. Multiple keys can be configured for same key chain.
R1(config-keychain-key)#send-lifetime 13:30:00 Jun 13 2012 duration 300	Use this command to specify the time period during which the authentication key on a key chain can be sent.
R1(config-keychain-key)#key-string ZebOS	Assign the key-string to the key.
R1(config-keychain)#key 15	Configure the key-ID for the keychain.
R1(config-keychain-key)#key-string IPI-ZebOS	Assign the key-string to the key.
R1(config-keychain-key)#exit	Exit from the Key mode.
R1(config-keychain)#exit	Exit from the Key Chain mode.
R1(config)#interface eth1	Enter the Interface configuration mode.
R1(config-if)#bfd session 2000::1 3000::1 multihop	Enable the BFD multihop session between peers. Note: For IPv4, provide the IPv4 source and destination addresses for the BFD session.
R1(config-if)#exit	Exit the interface mode.
R1(config)#bfd multihop-peer 3000::1 auth type keyed-sha1 key-chain IPInfusion	Enable the Authentication for BFD as Type-keyed-SHA1. Note: Configure authentication type as any one of mentioned types.
R1(config)#ipv6 route 3000::/64 2000::2	Configure the static route between the multihop BFD peers.
R1(config)#exit	Exit the Router mode.

**Router 3 (R3)**

R3#configure terminal	Enter the Configure mode.
R3(config)#key chain IPInfusion	Configure the key chain by assigning the string to it.
R3(config-keychain)#key 14	Configure key-ID for the keychain. Multiple keys can be configured for same key chain.
R3(config-keychain-key)#send-lifetime 13:30:00 Jun 13 2012 duration 300	Use this command to specify the time period during which the authentication key on a key chain can be sent.
R3(config-keychain-key)#key-string ZebOS	Assign the key-string to the key.
R3(config-keychain)#key 15	Configure the key-ID for the keychain.
R3(config-keychain-key)#key-string IPI-ZebOS	Assign the key-string to the key.
R3(config-keychain-key)#exit	Exit from the Key mode.
R3(config-keychain)#exit	Exit from the Key Chain mode.
R3(config)#interface eth1	Enter the Interface configuration mode.
R3(config-if)#bfd session 3000::1 2000::1 multihop	Enable the BFD multihop session between peers. Note: For IPv4, provide the IPv4 source and destination addresses for the BFD session.
R3(config-if)#exit	Exit the interface mode.
R3(config)#bfd multihop-peer 2000::1 auth type keyed-sha1 key-chain IPInfusion	Enable the Authentication for BFD as Type-keyed-SHA1. Note: Configure authentication type as any one of mentioned types.
R3(config)#ipv6 route 2000::/64 3000::2	Configure the static route between the multihop BFD peers.
R3(config)#exit	Exit the Router mode.

**Validation**

```

R1#show bfd session
Sess-Idx  Remote-Disc  Lower-Layer  Sess-Type  Sess-State  UP-Time  Remote-
Addr
1          1              IPv6         Multi-Hop  Up          00:09:17
3000::1/128
Number of Sessions: 1
DUT#sh bfd session detail
=====

Session Interface Index : 0          Session Index : 1
Lower Layer : IPv6              Version : 1
Session Type : Multihop Arbit Path  Session State : Up
Local Discriminator : 1          Local Address : 2000::1/128
Remote Discriminator : 1         Remote Address : 3000::1/128
Local Port : 49152              Remote Port : 14784
Options :

Diagnostics : None

Timers in Milliseconds :
Min Tx: 20                    Min Rx: 20                Multiplier: 5
Neg Tx: 20                    Neg Rx: 1000              Neg detect mult: 5
Min echo Tx: 20               Min echo Rx: 10           Neg echo intrvl: 0
Storage type : 2
Sess down time : 00:00:00

```



Sess discontinue time : 00:00:00  
 Bfd GTSM Disabled  
 Bfd Authentication Enabled  
 Authentication type : keyed-sha1  
 Authentication Key-id : 14

## Counters values:

Pkt In : 0000000000000000	Pkt Out : 0000000000000000
Echo Out : 0000000000000000	IPv6 Echo Out : 0000000000000000
IPv6 Pkt In : 000000000000096e0	IPv6 Pkt Out : 00000000000009788
UP Count : 2	UPTIME : 00:09:19

## Protocol Client Info:

BFD-> Client ID: 28                      Flags: 4

-----  
 Number of Sessions:            1

## R2#sh bfd session

Sess-Idx	Remote-Disc	Lower-Layer	Sess-Type	Sess-State	UP-Time	Remote-Addr
1	1	IPv6	Multi-Hop	Up	00:09:34	2000::1/128

Number of Sessions:            1

## R2#sh bfd session detail

=====

Session Interface Index : 0  
 Lower Layer : IPv6  
 Session Type : Multihop Arbit Path  
 Local Discriminator : 1  
 Remote Discriminator : 1  
 Local Port : 49152  
 Options :

Session Index : 1  
 Version : 1  
 Session State : Up  
 Local Address : 3000::1/128  
 Remote Address : 2000::1/128  
 Remote Port : 14784

Diagnostics : None

## Timers in Milliseconds :

Min Tx: 20	Min Rx: 20	Multiplier: 5
Neg Tx: 20	Neg Rx: 20	Neg detect mult: 5
Min echo Tx: 20	Min echo Rx: 10	Neg echo intrvl: 0
Storage type : 2		

Sess down time : 00:00:00

Sess discontinue time : 00:00:00

Bfd GTSM Disabled

Bfd Authentication Enabled

Authentication type : keyed-sha1

Authentication Key-id : 14

## Counters values:

Pkt In : 0000000000000000	Pkt Out : 0000000000000000
Echo Out : 0000000000000000	IPv6 Echo Out : 0000000000000000
IPv6 Pkt In : 00000000000009a73	IPv6 Pkt Out : 00000000000009a7e
UP Count : 2	UPTIME : 00:09:36

## Protocol Client Info:

BFD-> Client ID: 28                      Flags: 4

-----

Number of Sessions: 1

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