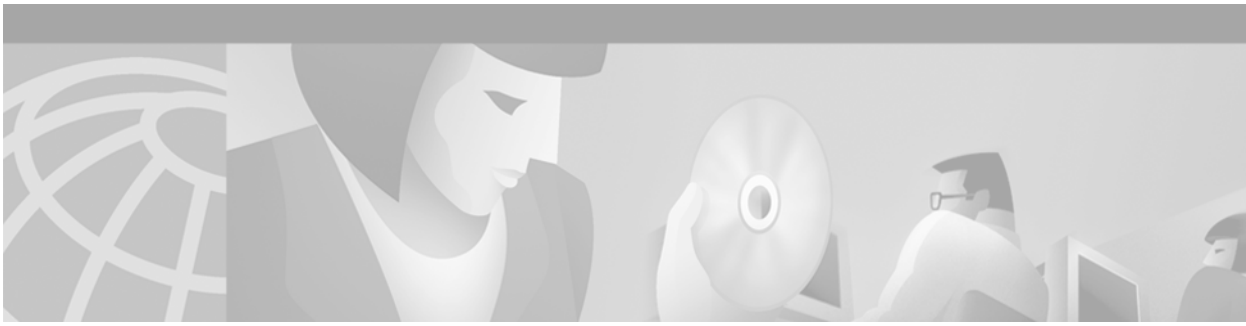


Configuring Unidirectional Link Routing

This chapter describes two approaches to achieve unidirectional link routing (UDLR). UDLR provides a way to forward multicast packets over a physical unidirectional interface (such as a satellite link of high bandwidth) to stub networks that have a back channel.

For a complete description of the commands in this chapter, refer to the "Unidirectional Link Routing Commands" chapter in the *Cisco IOS IP and IP Routing Command Reference* publication.

For information about tunnel interfaces, refer to the chapter "Configuring Logical Interfaces" in the *Cisco IOS Interface Configuration Guide*.

For information about Internet Group Management Protocol (IGMP), refer to the chapter "Configuring IP Multicast Routing" in the *Cisco IOS IP and IP Routing Configuration Guide*.

The Problem

Both unicast and multicast routing protocols forward data on interfaces from which they have received routing control information. That model works only on bidirectional links. The problem is how to accomplish two-way communication over satellite links, which are unidirectional. That is, how can the router perform unidirectional link routing?

To be more specific, in unicast routing, when a router receives an Update on an interface for a prefix, it forwards data for destinations that match that prefix out that same interface. This is the case in distance vector routing protocols.

Similarly, in multicast routing, when a router receives a Join for a multicast group on an interface, it forwards data destined for that group out that same interface. Based on these principles, existing unicast and multicast routing protocols cannot be supported over these unidirectional links.

The Solution

Cisco has two solutions for the unidirectional link problem. If you want to implement a unidirectional link to a satellite, choose one of the following solutions, depending on how many receivers you intend to send to.

UDLR Tunnel

One solution is to create a back channel (another link) so the routing protocols believe the one-way link is bidirectional. The back channel itself is a special, unidirectional, generic routing encapsulation (GRE) tunnel through which control traffic flows in the opposite direction of the user data flow. This feature allows IP and its associated unicast and multicast routing protocols to believe the unidirectional link is logically bidirectional.

This solution accommodates all IP unicast and multicast routing protocols without changing them. However, it does not scale as well as Cisco's second UDLR solution if many links to many receivers are involved. We recommend that no more than 20 tunnels feed into the upstream router.

The purpose of the unidirectional GRE tunnel is to move control packets from a downstream node to an upstream node.

The one-way tunnel is mapped to a one-way interface (that goes in the opposite direction). Mapping is performed at the link layer, so the one-way interface appears bidirectional. When the upstream node receives packets over the tunnel, it must make the upper-layer protocols act as if the packets were received on the send-capable unidirectional link.

IGMP Unidirectional Link Routing

Cisco's other UDLR solution is to use IP multicast routing with IGMP, which has been enhanced to accommodate UDLR. This solution scales very well for many satellite links.

Benefits

Unidirectional link routing allows a router to perform routing over a satellite link. A satellite link provides higher bandwidth and is less expensive to use than a terrestrial link. The cost for a receiver attachment is economically attractive.

The following compares the benefits of the two possible ways to achieve UDLR:

- The unidirectional tunnel is a general solution, in that it can handle any unicast IP routing protocol. However, it is not a good solution for thousands of receivers.
- IGMP UDLR supports IP multicast routing over unidirectional links. It is intended for large-scale multicast routing over unidirectional links.

Restrictions

- The UDLR tunnel should be used with extreme caution, because it does not scale well to a large number of tunnels. This solution is used primarily to deploy a point-to-point link over a satellite network using the link as a router-to-router transit subnet and not as a general-purpose, multiaccess transit subnet.
- All routers on the unidirectional link must have the same subnet address. If this cannot be achieved, the upstream router must be configured with secondary addresses to match all the subnets that the downstream routers are attached to.
- With IGMP UDLR, multicast receivers must be directly connected to the downstream routers.

Prerequisites

If you want to configure UDLR, you must decide which solution to implement. Based on how many receivers you expect to have, choose either a UDLR tunnel or IGMP UDLR. Both solutions are provided in this document.

Terms and Abbreviations

back channel—A link between two routers over which traffic can flow in the opposite direction of the unidirectional link between them. A back channel could be a unidirectional tunnel or a link over any number of routers.

downstream router—A router that receives traffic from a satellite link. It is assumed that this router has only a downstream connection to the satellite with receive-only capabilities.

unidirectional link routing (UDLR)—Routing over a one-way link to or from a satellite link. When used as an adjective to describe a tunnel, a UDLR tunnel is the back channel to complete the two-way communication between routers.

upstream router—A router that forwards data on a unidirectional link such as a satellite link. It is assumed that this router has only an upstream connection to the satellite with send-only capabilities.

Configuration Tasks for a UDLR Tunnel

The unidirectional tunnel does not require an **ip address** or **ip unnumbered** command. That is, you do not assign an IP address to the tunnel, but you must configure the tunnel endpoint addresses.

Use all of the following required commands to configure a UDLR tunnel. The tunnel mode defaults to GRE.

On the upstream router, where the unidirectional link can only send, configure the tunnel to receive. Use the following commands beginning in global configuration mode. When packets are received over the tunnel, the upper layer protocols think the packet is received over the unidirectional, send-only interface.

Command	Purpose
interface *type number*	Configures the unidirectional send-only interface.
interface tunnel *number*	Configures the receive-only tunnel interface.
tunnel udlr receive-only *type number*	Configures the UDLR tunnel. Use the same *type* and *number* as the unidirectional SEND-ONLY interface *type* and *number* specified with the **interface** *type number* command.
tunnel source {*ip-address* | *type number*}	Configures the tunnel source.
tunnel destination {*hostname* | *ip-address*}	Configures the tunnel destination.

On the downstream router, where the unidirectional link can only receive, configure the tunnel to send. Use the following commands beginning in global configuration mode. When packets are sent by upper layer protocols over the interface, they will be redirected and sent over this GRE tunnel.

Command	Purpose
interface *type number*	Configures the unidirectional receive-only interface.
interface tunnel *number*	Configures the send-only tunnel interface.
tunnel udlr send-only *type number*	Configures the UDLR tunnel. Use the same *type* and *number* as the unidirectional RECEIVE-ONLY interface *type* and *number* specified with the **interface** *type number* command.
tunnel source {*ip-address* | *type number*}	Configures the tunnel source.
tunnel destination {*hostname* | *ip-address*}	Configures the tunnel destination.

For an example of a UDLR tunnel, see the section "UDLR Tunnel Example" at the end of this chapter.

Configuration Tasks for IGMP UDLR

Perform the following tasks to configure IGMP UDLR. The first task is required; the remaining task is optional.

- Configuring the IGMP Unidirectional Link
- Changing the Distance for the Default RPF Interface

Configuring the IGMP Unidirectional Link

To configure an IGMP unidirectional link, configure the upstream and downstream routers. You need not specify whether the direction is sending or receiving; IGMP learns the direction by the nature of the physical connection.

On the upstream router, use the following command in interface configuration mode:

Command	Purpose
ip igmp unidirectional-link	Configures IGMP on the interface to be unidirectional.

On the downstream router, use the following commands in interface configuration mode. When the router receives an IGMP report from a host, the router helpers that report to the IGMP querier associated with the unidirectional link interface identified in the **ip igmp helper-address** command.

Command	Purpose
ip igmp unidirectional-link	Configures IGMP on the interface to be unidirectional.
ip igmp helper-address udl *type number*	Configures the interface to be an IGMP helper. Use this command on every downstream router, on every interface to a potential multicast receiver. Specify the *type* and *number* that identify the unidirectional link interface.

Changing the Distance for the Default RPF Interface

By default, the distance for the default Reverse Path Forwarding (RPF) interface is 15. Any explicit sources learned by routing protocols will take preference if their distance is less than the distance configured by the **ip multicast default-rpf-distance** command.

If you want IGMP to prefer the UDLR link, set the distance to be less than the distances of the unicast routing protocols. If you want IGMP to prefer the non-UDLR link, set the distance to be greater than the unicast routing protocols' distances. This task might be required on downstream routers if you want to have some sources RPF to the UDLR link and others through the terrestrial paths.

To configure one of these preferences, use the following command in global configuration mode:

Command	Purpose
ip multicast default-rpf-distance *distance*	Changes the distance for the default RPF interface.

Monitoring IGMP Unidirectional Link Routing

To display UDLR information for directly connected groups on interfaces that have a unidirectional link helper address configured, use the following command in EXEC mode:

Command	Purpose
show ip igmp udlr [*groupname-or-address* | *interface-unit*]	Displays UDLR information for directly connected multicast groups on interfaces that have a unidirectional link helper address configured.

Configuration Examples

The following examples each illustrate a different approach to UDLR. The first example is the tunnel approach, and the second example is the IGMP approach.

- UDLR Tunnel Example
- IGMP UDLR Example

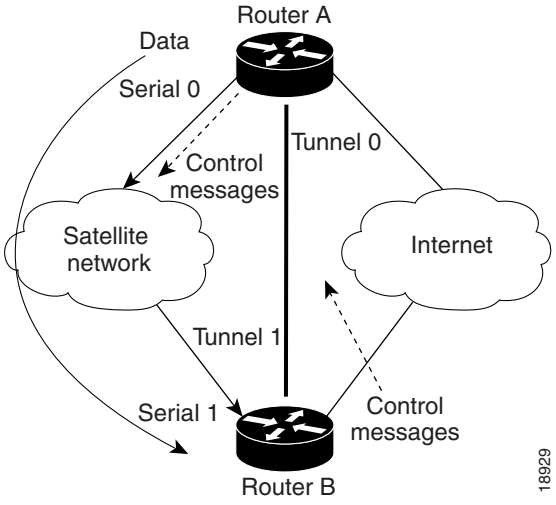
UDLR Tunnel Example

Figure 65 illustrates a UDLR tunnel. In the example, Router A (the upstream router) is configured with Open Shortest Path First (OSPF) and Protocol-Independent Multicast (PIM). Serial interface 0 has send-only capability. Therefore, the UDLR tunnel is configured as receive only, and points to Serial 0.

Router B (the downstream router) is configured with OSPF and PIM. Serial interface 1 has receive-only capability. Therefore, the UDLR tunnel is configured as send-only, and points to Serial 1.

The configurations for the two routers follow the figure.

Figure 65 UDLR Tunnel Example



Router A

```
ip multicast-routing
!
! Serial0 has send-only capability
!
interface serial 0
 encapsulation hdlc
 ip address 10.1.0.1 255.255.0.0
 ip pim sparse-dense-mode
!
! Configure tunnel as receive-only UDLR tunnel.
!
interface tunnel 0
 tunnel source 11.0.0.1
 tunnel destination 11.0.0.2
 tunnel udlr receive-only serial 0
!
! Configure OSPF.
!
router ospf <pid>
 network 10.0.0.0 0.255.255.255 area 0
```

Router B

```
ip multicast-routing
!
! Serial1 has receive-only capability
!
interface serial 1
 encapsulation hdlc
 ip address 10.1.0.2 255.255.0.0
 ip pim sparse-dense-mode

!
! Configure tunnel as send-only UDLR tunnel.
!
```

```
interface tunnel 0
 tunnel source 11.0.0.2
 tunnel destination 11.0.0.1
 tunnel udlr send-only serial 1
!
! Configure OSPF.
!
router ospf <pid>
 network 10.0.0.0 0.255.255.255 area 0
```

IGMP UDLR Example

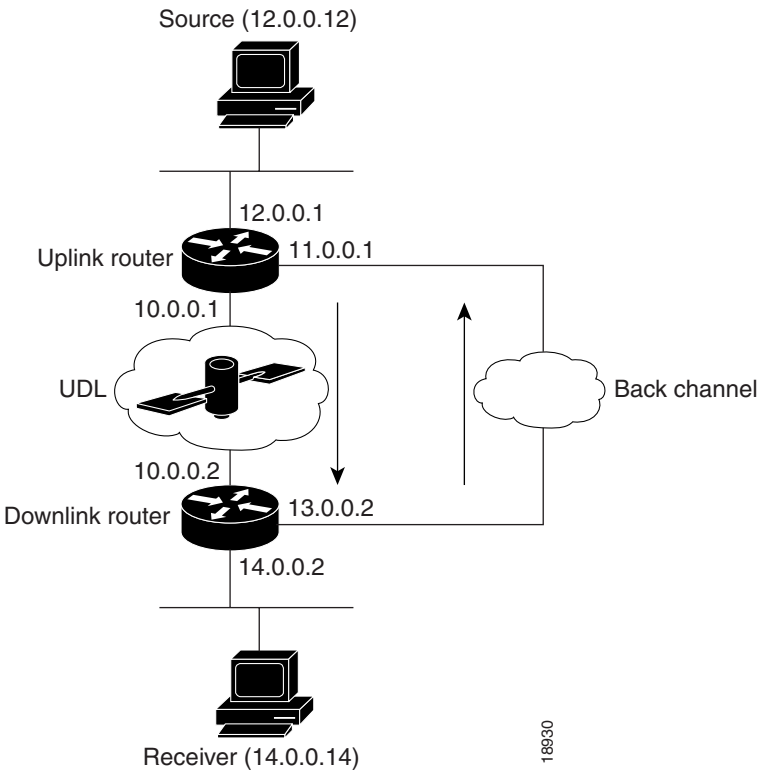
In the following example, uplink-rtr is the local upstream router and downlink-rtr is the downstream router. Figure 66 illustrates the example, and the configurations of the two routers follow.

Both routers are also connected to each other by a back channel connection. Both routers have two IP addresses: one on the unidirectional link and one on the interface that leads to the back channel. The back channel is any return route and can have any number of routers.

Note Configuring PIM on the back channel interfaces on the uplink router and downlink router is optional.

All routers on a unidirectional link must have the same subnet address. If this cannot be achieved, the upstream router must be configured with secondary addresses to match all the subnets that the downstream routers are attached to.

Figure 66 IGMP Unidirectional Link Routing Example



Uplink Router (uplink-rtr)

```
ip multicast-routing
!
! Interface that source is attached to
!
interface ethernet 0
 description Typical IP multicast enabled interface
 ip address 12.0.0.1 255.0.0.0
 ip pim sparse-dense-mode
!
! Back channel
!
interface ethernet 1
 description Back channel which has connectivity to downlink-rtr
 ip address 11.0.0.1 255.0.0.0
 ip pim sparse-dense-mode
!
! Unidirectional link
!
interface serial 0
 description Unidirectional to downlink-rtr
 ip address 10.0.0.1 255.0.0.0
 ip pim sparse-dense-mode
 ip igmp unidirectional-link
 no keepalive
```

Downlink Router (downlink-rtr)

```
ip multicast-routing
!
! Interface that receiver is attached to, configure for IGMP reports to be
! helpered for the unidirectional interface.
!
interface ethernet 0
 description Typical IP multicast-enabled interface
 ip address 14.0.0.2 255.0.0.0
 ip pim sparse-dense-mode
 ip igmp helper-address udl serial 0
!
! Back channel
!
interface ethernet 1
 description Back channel that has connectivity to downlink-rtr
 ip address 13.0.0.2 255.0.0.0
 ip pim sparse-dense-mode
!
! Unidirectional link
!
interface serial 0
 description Unidirectional to uplink-rtr
 ip address 10.0.0.2 255.0.0.0
 ip pim sparse-dense-mode
 ip igmp unidirectional-link
 no keepalive
```