Example: Conditionally Generating Static Routes

Understanding Conditionally Generated Routes

Generated routes are used as the *route of last resort*. A packet is forwarded to the route of last resort when the routing tables have no information about how to reach that packet's destination. One use of route generation is to generate a default route to use if the routing table contains a route from a peer on a neighboring backbone.

A generated route becomes active when it has one or more *contributing routes*. A contributing route is an active route that is a more specific match for the generated destination. For example, for the destination 128.100.0.0/16, routes to 128.100.192.0/19 and 128.100.67.0/24 are contributing routes, but routes to 128.0.0.0./8, 128.0.0.0/16, and 128.100.0.0/16 are not.

A route can contribute only to a single generated route. However, an active generated route can recursively contribute to a less specific matching generated route. For example, a generated route to the destination 128.100.0.0/16 can contribute to a generated route to 128.96.0.0/13.

By default, when generated routes are installed in the routing table, the next hop is chosen from the primary contributing route.

> **Note:** You can configure only one generated route for each destination prefix.

To configure generated routes in the default routing table (inet.0), include the generate statement:

```
generate {
    (defaults | route destination ) {
        (active | passive);
        as-path <as-path> <origin (egp | igp | incomplete)> <atomic-aggregate> <aggregator as-number in-address>;
        community [ community-ids ];
        discard;
        (brief | full);
        (metric | metric2 | metric3 | metric4) metric <type type>;
        policy policy-name;
        (preference | preference2 | color | color2) preference <type type>;
        tag string;
    }
}
```

> **Note:** You cannot configure generated routes for the IPv4 multicast routing table (inet.1) or the IPv6 multicast routing table (inet6.1).

The generate statement consists of two parts:

- defaults—Here you specify global generated route options. These are treated as global defaults and apply to all the generated routes you configure in the generate statement. This part of the generate statement is optional.
- route—Here you configure individual generated routes. In this part of the generate statement, you optionally can configure generated route options. These options apply to the individual destination only and override any options you configured in the defaults part of the generate statement.

Example: Configuring a Conditional Default Route Policy

This example shows how to configure a conditional default route on one routing device and redistribute the default route into OSPF.

- Requirements
- Overview
- Configuration
- Verification

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

In this example, OSPF area 0 contains three routing devices. Device R3 has a BGP session with an external peer, for example, an Internet Service Provider (ISP).

To propagate a static route into BGP, this example includes the discard statement when defining the route. The ISP injects a default static route into BGP, which provides the customer network with a default static route to reach external networks. The static route has a discard next hop. This means that if a packet does not match a more specific route, the packet is rejected and a reject route for this destination is installed in the routing table, but Internet Control Message Protocol (ICMP) unreachable messages are not sent. The discard next hop allows you to originate a summary route, which can be advertised through dynamic routing protocols.

Device R3 exports the default route into OSPF. The route policy on Device R3 is conditional such that if the connection to the ISP goes down, the default route is no longer exported into OSPF because it is no longer active in the routing table. This policy prevents packets from being silently dropped without notification (also known as blackholing).

This example shows the configuration for all of the devices and the step-by-step configuration on Device R3.

Figure 1 shows the sample network.

Figure 1: OSPF with a Conditional Default Route to an ISP
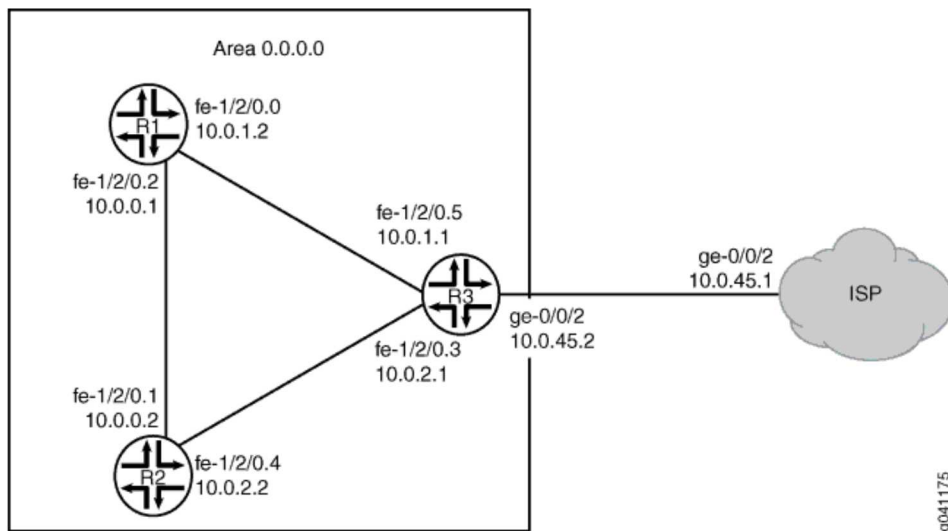
Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 0 description R1->R3
set interfaces fe-1/2/0 unit 0 family inet address 10.0.1.2/30
set interfaces fe-1/2/1 unit 2 description R1->R2
set interfaces fe-1/2/1 unit 2 family inet address 10.0.0.1/30
set protocols ospf area 0.0.0.0 interface fe-1/2/0.0
set protocols ospf area 0.0.0.0 interface fe-1/2/1.2
```

Device R2

```
set interfaces fe-1/2/0 unit 1 description R2->R1
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 4 description R2->R3
set interfaces fe-1/2/1 unit 4 family inet address 10.0.2.2/30
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
```

Device R3

```
set interfaces fe-1/2/0 unit 3 description R3->R2
set interfaces fe-1/2/0 unit 3 family inet address 10.0.2.1/30
set interfaces fe-1/2/1 unit 5 description R3->R1
set interfaces fe-1/2/1 unit 5 family inet address 10.0.1.1/30
set interfaces ge-0/0/2 unit 0 description R3->ISP
set interfaces ge-0/0/2 unit 0 family inet address 10.0.45.2/30
set protocols bgp group ext type external
set protocols bgp group ext peer-as 65000
set protocols bgp group ext neighbor 10.0.45.1
set protocols ospf export gendefault
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set protocols ospf area 0.0.0.0 interface fe-1/2/0.3
set policy-options policy-statement gendefault term upstreamroutes from protocol bgp
set policy-options policy-statement gendefault term upstreamroutes from as-path upstream
set policy-options policy-statement gendefault term upstreamroutes from route-filter 0.0.0.0/0 upto /16
set policy-options policy-statement gendefault term upstreamroutes then next-hop 10.0.45.1
set policy-options policy-statement gendefault term upstreamroutes then accept
set policy-options policy-statement gendefault term end then reject
set policy-options as-path upstream "^65000 "
set routing-options generate route 0.0.0.0/0 policy gendefault
set routing-options autonomous-system 65001
```

Device ISP

```
set interfaces ge-0/0/2 unit 0 family inet address 10.0.45.1/30
set protocols bgp group ext type external
set protocols bgp group ext export advertise-default
set protocols bgp group ext peer-as 65001
set protocols bgp group ext neighbor 10.0.45.2
set policy-options policy-statement advertise-default term 1 from route-filter 0.0.0.0/0 exact
set policy-options policy-statement advertise-default term 1 then accept
set routing-options static route 0.0.0.0/0 discard
set routing-options autonomous-system 65000
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see Using the CLI Editor in Configuration Mode in the *Junos OS CLI User Guide* .

To configure Device R3:

1. Configure the interfaces.
```
[edit interfaces]
user@R3# set fe-1/2/0 unit 3 description R3->R2
user@R3# set fe-1/2/0 unit 3 family inet address 10.0.2.1/30
user@R3# set fe-1/2/1 unit 5 description R3->R1
user@R3# set fe-1/2/1 unit 5 family inet address 10.0.1.1/30
user@R3# set ge-0/0/2 unit 0 description R3->ISP
user@R3# set ge-0/0/2 unit 0 family inet address 10.0.45.2/30
```

2. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R3# set autonomous-system 65001
```

3. Configure the BGP session with the ISP device.
```
[edit protocols bgp group ext]
user@R3# set type external
user@R3# set peer-as 65000
user@R3# set neighbor 10.0.45.1
```

4. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R3# set interface fe-1/2/1.4
user@R3# set interface fe-1/2/0.3
```

5. Configure the routing policy.

```
[edit policy-options policy-statement gendefault]
user@R3# set term upstreamroutes from protocol bgp
user@R3# set term upstreamroutes from as-path upstream
user@R3# set term upstreamroutes from route-filter 0.0.0.0/0 upto /16
user@R3# set term upstreamroutes then next-hop 10.0.45.1
user@R3# set term upstreamroutes then accept

user@R3# set term end then reject

[edit policy-options]
user@R3# set as-path upstream "^65000 "
```

6. Configure the generated route, associating the routing policy with the generated route.

```
[edit routing-options]
user@R3# set generate route 0.0.0.0/0 policy gendefault
```

7. Apply the export policy to OSPF.

```
[edit protocols ospf]
user@R3# set export gendefault
```

8. If you are done configuring the device, commit the configuration.

```
[edit]
user@R3# commit
```

Results

Confirm your configuration by issuing the show command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show
interfaces {
    fe-1/2/0 {
        unit 3 {
            description R3->R2;
            family inet {
                address 10.0.2.1/30;
            }
        }
    }
    fe-1/2/1 {
        unit 5 {
            description R3->R1;
            family inet {
                address 10.0.1.1/30;
            }
        }
    }
    ge-1/2/0 {
        unit 0 {
            description R3->ISP;
            family inet {
                address 10.0.45.2/30;
            }
        }
    }
}
protocols {
    bgp {
        group ext {
            type external;
            peer-as 65000;
            neighbor 10.0.45.1;
        }
    }
    ospf {
        export gendefault;
        area 0.0.0.0 {
```

```
                        interface fe-1/2/1.4;
                        interface fe-1/2/0.3;
                }
        }
}
policy-options {
        policy-statement gendefault {
                term upstreamroutes {
                        from {
                                protocol bgp;
                                as-path upstream;
                                route-filter 0.0.0.0/0 upto /16;
                        }
                        then {
                                next-hop 10.0.45.1;
                                accept;
                        }
                }
                term end {
                        then reject;
                }
        }
        as-path upstream "^65000 ";
}
routing-options {
        generate {
                route 0.0.0.0/0 policy gendefault;
        }
        autonomous-system 65001;
}
```

Verification

Confirm that the configuration is working properly.

- Verifying That the Route to the ISP Is Working
- Verifying That the Static Route Is Redistributed
- Testing the Policy Condition

Verifying That the Route to the ISP Is Working

Purpose

Make sure connectivity is established between Device R3 and the ISP's router.

Action

```
user@R3> ping 10.0.45.1
PING 10.0.45.1 (10.0.45.1): 56 data bytes
64 bytes from 10.0.45.1: icmp_seq=0 ttl=64 time=1.185 ms
64 bytes from 10.0.45.1: icmp_seq=1 ttl=64 time=1.199 ms
64 bytes from 10.0.45.1: icmp_seq=2 ttl=64 time=1.186 ms
```

Meaning

The ping command confirms reachability.

Verifying That the Static Route Is Redistributed

Purpose

Make sure that the BGP policy is redistributing the static route into Device R3's routing table. Also make sure that the OSPF policy is redistributing the static route into the routing tables of Device R1 and Device R2.

Action

```
user@R3> show route protocol bgp
inet.0: 9 destinations, 10 routes (9 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[BGP/170] 00:00:25, localpref 100
                     AS path: 65000 I
                    > to 10.0.45.1 via ge-0/0/2.6
user@R1> show route protocol ospf
inet.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[OSPF/150] 00:03:58, metric 0, tag 0
                    > to 10.0.1.1 via fe-1/2/0.0
10.0.2.0/30        *[OSPF/10] 03:37:45, metric 2
                     to 10.0.1.1 via fe-1/2/0.0
                    > to 10.0.0.2 via fe-1/2/1.2
224.0.0.5/32       *[OSPF/10] 03:38:41, metric 1
                     MultiRecv
user@R2> show route protocol ospf
inet.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[OSPF/150] 00:04:04, metric 0, tag 0
                    > to 10.0.2.1 via fe-1/2/1.4
10.0.1.0/30        *[OSPF/10] 03:37:46, metric 2
                     to 10.0.0.1 via fe-1/2/0.1
                    > to 10.0.2.1 via fe-1/2/1.4
```

```
224.0.0.5/32        *[OSPF/10] 03:38:47, metric 1
                       MultiRecv
```

Meaning

The routing tables contain the default 0.0.0.0/0 route. If Device R1 and Device R2 receive packets destined for networks not specified in their routing tables, those packets will be sent to Device R3 for further processing. If Device R3 receives packets destined for networks not specified in its routing table, those packets will be sent to the ISP for further processing.

Testing the Policy Condition

Purpose

Deactivate the interface to make sure that the route is removed from the routing tables if the external network becomes unreachable.

Action

```
user@R3> deactivate interfaces ge-0/0/2 unit 0 family inet address 10.0.45.2/30

user@R3> commit
user@R1> show route protocol ospf
inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.2.0/30        *[OSPF/10] 03:41:48, metric 2
                       to 10.0.1.1 via fe-1/2/0.0
                    > to 10.0.0.2 via fe-1/2/1.2
224.0.0.5/32       *[OSPF/10] 03:42:44, metric 1
                       MultiRecv

user@R2> show route protocol ospf
inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.1.0/30        *[OSPF/10] 03:42:10, metric 2
                       to 10.0.0.1 via fe-1/2/0.1
                    > to 10.0.2.1 via fe-1/2/1.4
224.0.0.5/32       *[OSPF/10] 03:43:11, metric 1
                       MultiRecv
```

Meaning

The routing tables on Device R1 and Device R2 do not contain the default 0.0.0.0/0 route. This verifies that the default route is no longer present in the OSPF domain. To reactivate the `ge-0/0/2.6` interface, issue the `activate interfaces ge-0/0/2 unit 0 family inet address 10.0.45.2/30` configuration mode command.

Related Documentation

M Series

- Example: Summarizing Static Routes Through Route Aggregation

MX Series

- Example: Summarizing Static Routes Through Route Aggregation

T Series

- Example: Summarizing Static Routes Through Route Aggregation

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