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EIGRP to OSPF Migration Strategies

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ABSTRACT

Networking has evolved immensely in recent years. Standards based protocols have become a requirement for today's networks. Many networks in the past were constructed with vendor proprietary protocols. Unfortunately this type of design precludes best of breed architectures. This paper will show how to migrate a network from EIGRP to OSPF.

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Introduction

Modern day networks hardly resemble the designs of their predecessors. One of the areas that has seen the most significant evolution pertains to IP routing protocols. IP routing was initially performed on UNIX workstations running RouteD which supported RIP. RouteD was extremely lightweight which was necessary for routers of that era. Unfortunately RIP could not scale to meet the needs of a growing internetwork. Newer and improved protocols like OSPF, IS-IS, and EIGRP were developed as a replacement to RIP. When EIGRP was developed it made sense as it had significant scalability enhancements over RIP and was very CPU efficient. EIGRP was designed with efficiency of router resources in mind. EIGRP did not scale to the degree of newer link state protocols but given the router's inherent CPU and memory limitations it was an ideal tradeoff. Since EIGRP was a resource optimized protocol many networks were designed with EIGRP as a routing protocol.

Routers of today have tremendous performance enhancements when compared to their predecessors. In order to facilitate more efficient routing today's routers have significant increases in CPU and memory resources. With the evolution high performance routers it is no longer desirable to choose a lightweight protocol at the expense of scalability.

EIGRP has another significant problem in that it is vendor proprietary. The customer using EIGRP is locked into a single vendor solution for all of their internetwork hardware. When EIGRP was developed this was not a significant problem as there was really not a lot of choice for network designers to choose from. Today's network architects have many different platforms from which to choose. Using a standards based protocol allows the network designer to choose a best of breed architecture.

If scalability and vendor agnostics were not a sufficient reason to choose a link state protocol there is another important limitation of EIGRP. EIGRP cannot support MPLS traffic engineering. MPLS traffic engineering requires a link state protocol for the detailed topological information contained in the link state database. Since MPLS traffic engineering or the potential to include it in a network design is rapidly becoming a requirement a link state protocol is needed in most if not all modern networks.

Given all of the reasons discussed networks of today and the foreseeable future run link state protocols. The most commonly used link state protocol is OSPF. This paper will describe migration strategies from EIGRP to OSPF.

Routing Protocol Upgrade

It has been determined that the network can glean significant benefits from migrating to OSPF. How this migration is performed is often a daunting question to the network designer. This process is not as complicated as one might think.

There are generally two methods to perform a network integration of two different routing protocols. One is route redistribution and the other is routing protocol migration. Each of these strategies has benefits and disadvantages. Both will be described.

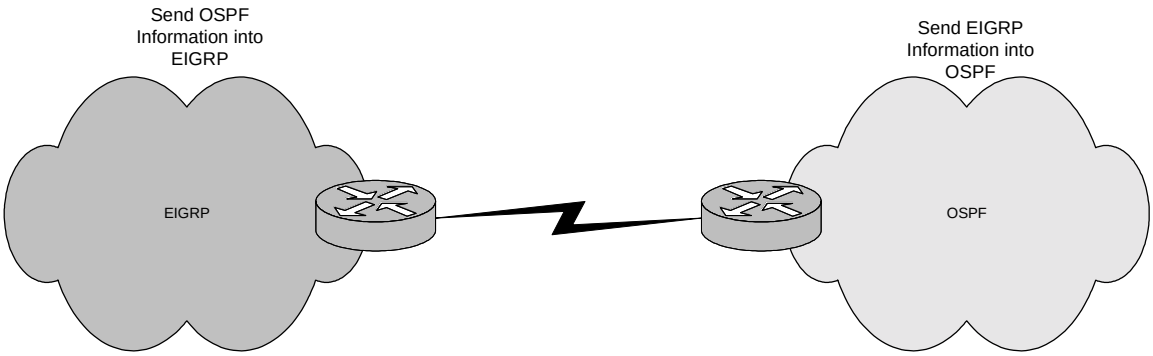
Route Redistribution

The first topic that will be covered is route redistribution. Route redistribution involves taking the information from one routing protocol and injecting it into another protocol. Route redistribution has the obvious advantage in that it does not require a lot of additional resources on all of the routers in the domain. Since all routers do not need to maintain the information from two routing databases concurrently, there is not a lot state required like there is in a protocol migration scenario. The only routers that need to maintain both routing databases are the boundary routers. The process works as follows. On boundary routers two different routing protocols are run. The boundary routers take the information learned from one protocol and translate it to the other protocol. During the translation it becomes necessary to translate subnets and metrics between the routing protocols.

See Figure 1 for an example of route redistribution.

Figure 1

Figure 1 is a general representation of EIGRP and OSPF mutual redistribution. In mutual redistribution all OSPF subnets are exported to EIGRP. EIGRP learned subnets are exported into the OSPF domain. Appropriate metrics are added at redistribution points to aid in the translation.

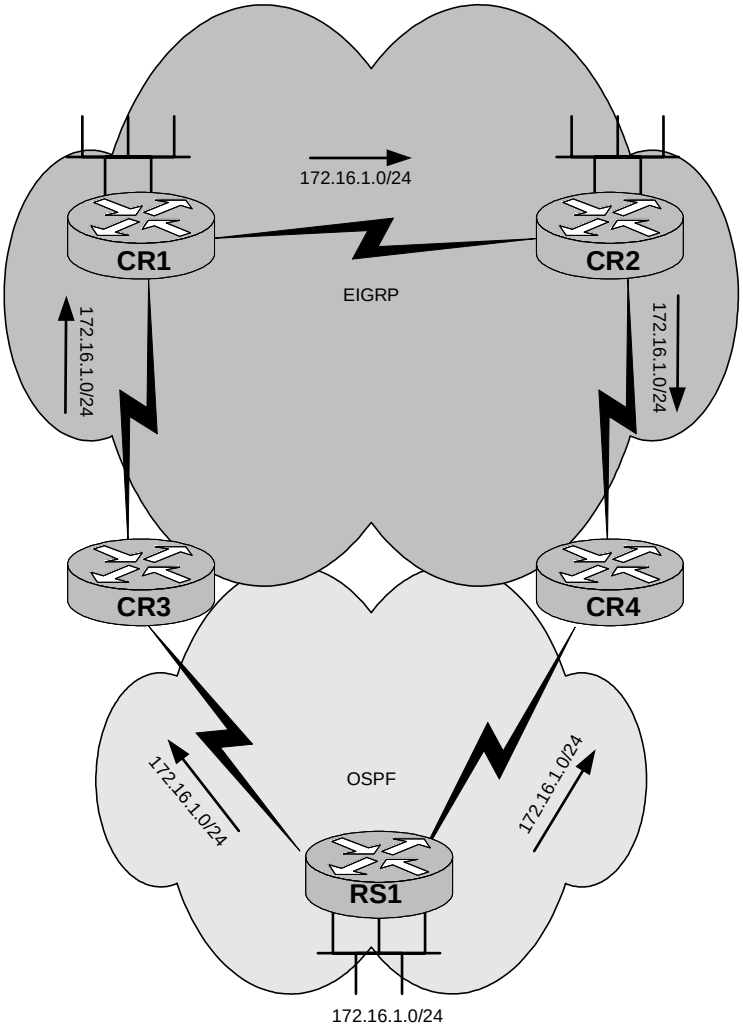


A significant drawback to Route Redistribution is that it becomes fairly complicated very quickly. When mutual route redistribution is performed and there is more than one redistribution point route-feedback loops often occur. This can be prevented with careful filtering; however it can be a tricky scenario and a large administrative burden at best. There are several ways to prevent routing loops during route-redistribution. These methods include route-tagging and route filtering. The key is to allow only the redistributed subnets to be exchanged at redistribution points. The figure below will show a route-feedback loop. The configuration sections of this document will show how to avoid feedback loops during route-redistribution.

Figure 2

Figure 2 depicts a routing loop caused by route redistribution. In this example RS1 advertises a subnet 172.16.11.0/24 to its neighbors. While inside the EIGRP domain this route becomes advertised back to the OSPF domain. This causes a routing loop caused by route feedback.

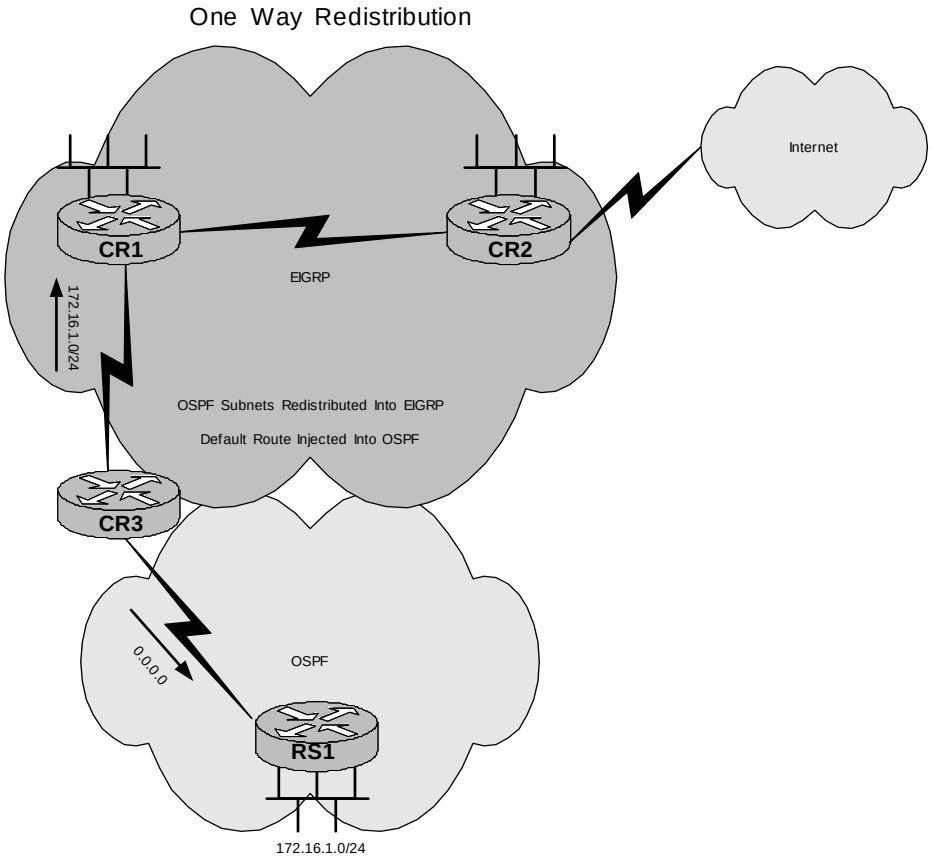
Route Redistribution Feedback Loop



Route redistribution becomes highly feasible when there is only one redistribution point. This is because the subnets from the new protocol can be exported into the established routing domain and a single default route can be used to give reachability for the stub domain into the main network. This is valid only in the environment where the stub domain gets its internet access through the core. If the stub domain has local internet access this method is not feasible. The diagram below shows an example of a simple one-way route redistribution scenario.

Figure 3

Figure 3 depicts and environment where one way redistribution is highly effective. In this scenario all of the OSPF subnets are exported into EIGRP. A default route is used to allow the OSPF domain reachability into the EIGRP domain.



Since route redistribution often becomes reasonably complicated and demands high administrative burdens it is recommended to perform routing protocol migrations whenever possible.

Routing Migration

As stated the recommended interoperability approach is routing protocol migration. This process involves temporarily running both protocols concurrently in a ships in the night matter, meaning that the protocol routes are not shared between each other. Finally, when both protocols are running and fully operational the old protocol is removed. The drawback to this approach is that during the migration the memory and CPU requirements are increased for all routers involved. This is because all routers will need to maintain both routing databases. This is generally not a problem for today's high performance routers.

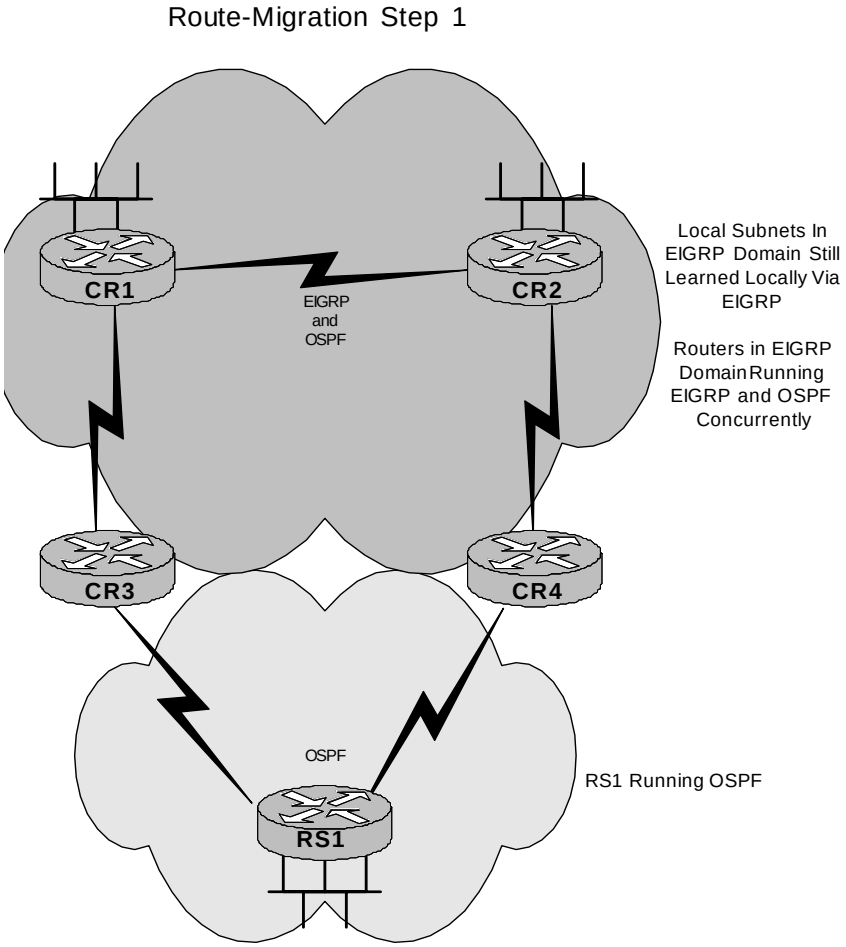
There are significant benefits to this approach. An immediate benefit is that this is not a very complex process. The network will not be susceptible to route redistribution loops. Therefore this approach offers little administrative burden. Most importantly the "new network" will have all of the scalability enhancements of a link state protocol and will be able to support next generation protocols like MPLS traffic engineering.

The figures below will show the manner in which a routing protocol migration should be performed.

The figures below will show the theory of how this process is performed. In the first phase of the migration both routing protocols are run on all routers in the domain.

Figure 4

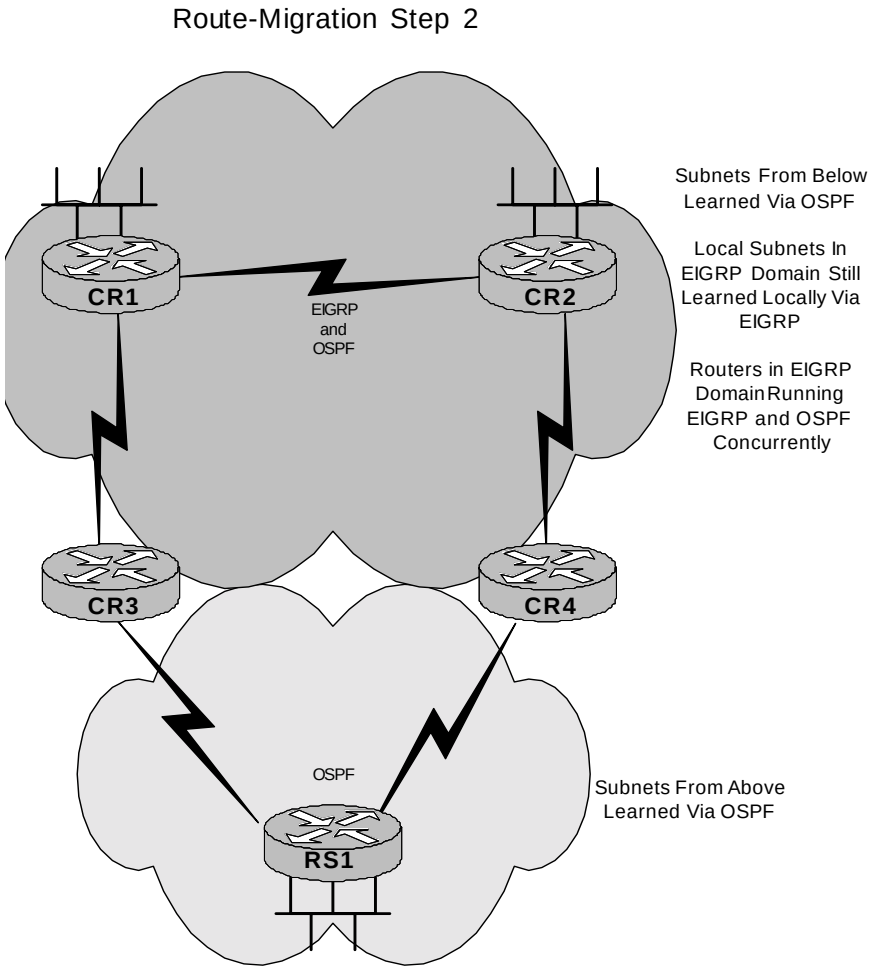
In figure 4 the routers are running EIGRP and OSPF concurrently. All routers in the domain have both sets of routing databases. The routes in the EIGRP domain will be learned via EIGRP due to its lower administrative distance. The routers in the OSPF domain will learn their routes via OSPF.



In the next phase of the migration it is necessary to verify that routes are being learned from both protocols. Since EIGRP has a lower administrative distance than OSPF, the OSPF learned subnets will not show up in the routing table of the routers in the EIGRP domain. Therefore it is necessary to verify the presence of LSA for these subnets in the routers LSA database.

Figure 5

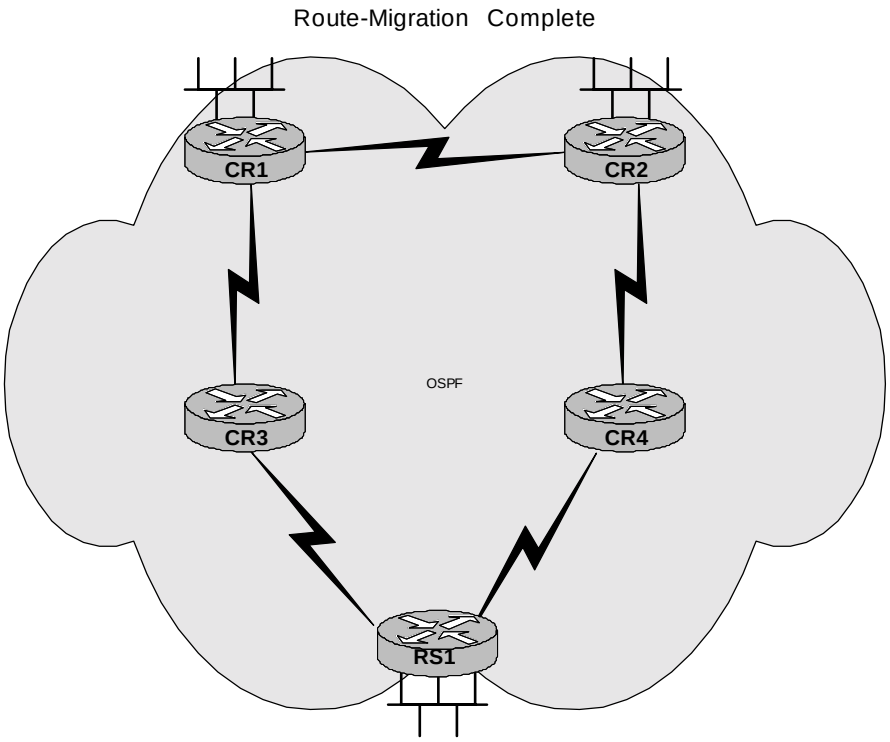
In Figure 5 both protocols are running. The existence of OSPF routing information is verified in the OSPF LSA database in the routers in the EIGRP/OSPF domain.



Since full routing information is now available via OSPF it is safe to remove EIGRP. EIGRP s therefore removed and the network is running entirely on OSPF.

Figure 6

In Figure 6 all migrations have been completed. The network is running on a highly efficient link state protocol.



EIGRP to OSPF Migration Examples

The first example will include a route redistribution scenario between EIGRP and OSPF. After the redistribution example an EIGRP to OSPF protocol migration will be performed.

EIGRP to OSPF Redistribution

This paper will now begin a step by step method to perform EIGRP and OSPF redistribution. Before beginning it is necessary to show the baseline network. Full configurations from the baseline network can be seen in appendix A. This network will be used for both the route redistribution scenario and the route migration scenario. The next several figures will show the configuration from several points in the network.

The steps required for effective route redistribution can be summarized below.

1. Plan necessary route filters.
3. Apply necessary filters.
4. Redistribute the subnets between each protocol.
5. Define metrics for redistributed subnets.
6. Verify routing.

Figure 7

In Figure 7 we have the baseline network. Note there are two separate EIGRP and OSPF domains which do not have reachability with each other.

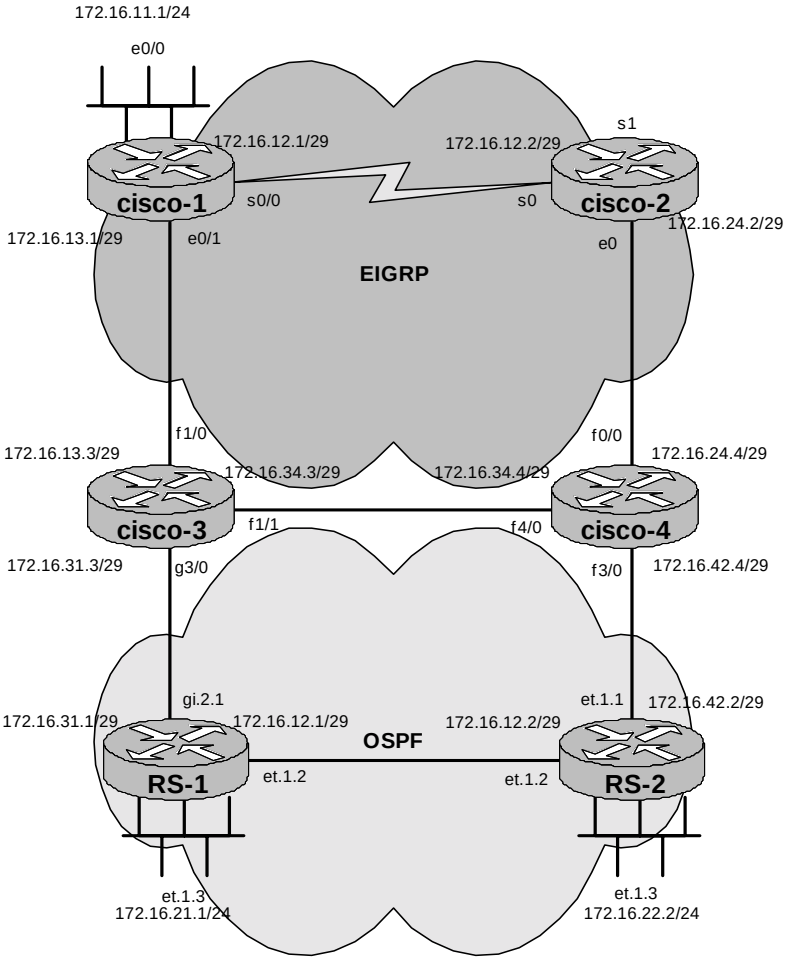


Figure 8

In Figure 8 there is a view of the network from the perspective of cisco-1. Note its configuration includes only EIGRP and its routing table includes only EIGRP routes. For a topological view of this network see figure 7.

```
router eigrp 1
 network 172.16.0.0
 network 192.168.1.0
 no auto-summary
 eigrp log-neighbor-changes

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

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 7 subnets, 2 masks
D       172.16.42.0/29 [90/286720] via 172.16.13.3, 01:45:47, Ethernet0/1
D       172.16.34.0/29 [90/284160] via 172.16.13.3, 01:45:48, Ethernet0/1
D       172.16.31.0/29 [90/281856] via 172.16.13.3, 01:45:48, Ethernet0/1
D       172.16.24.0/29 [90/286720] via 172.16.13.3, 01:45:47, Ethernet0/1
C       172.16.12.0/29 is directly connected, Serial0/0
C       172.16.13.0/29 is directly connected, Ethernet0/1
C       172.16.11.0/24 is directly connected, Ethernet0/0
     192.168.4.0/32 is subnetted, 1 subnets
D       192.168.4.4 [90/412160] via 172.16.13.3, 01:43:56, Ethernet0/1
     192.168.1.0/32 is subnetted, 1 subnets
C       192.168.1.1 is directly connected, Loopback0
     192.168.2.0/32 is subnetted, 1 subnets
D       192.168.2.2 [90/414720] via 172.16.13.3, 01:42:18, Ethernet0/1
     192.168.3.0/32 is subnetted, 1 subnets
D       192.168.3.3 [90/409600] via 172.16.13.3, 01:40:38, Ethernet0/1
```

Figure 9

In Figure 9 there is a view of the network from the perspective of cisco-2. Note its configuration includes only EIGRP and its routing table includes only EIGRP routes. For a topological view of this network see figure 7.

```
router eigrp 1
 network 172.16.0.0
 network 192.168.2.0
 no auto-summary
 eigrp log-neighbor-changes

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

Gateway of last resort is not set
```

```
     172.16.0.0/16 is variably subnetted, 7 subnets, 2 masks
D       172.16.42.0/29 [90/284160] via 172.16.24.4, 01:39:49, Ethernet0
D       172.16.34.0/29 [90/284160] via 172.16.24.4, 01:39:50, Ethernet0
D       172.16.31.0/29 [90/284416] via 172.16.24.4, 01:39:50, Ethernet0
C       172.16.24.0/29 is directly connected, Ethernet0
C       172.16.12.0/29 is directly connected, Serial0
D       172.16.13.0/29 [90/309760] via 172.16.24.4, 01:39:50, Ethernet0
D       172.16.11.0/24 [90/335360] via 172.16.24.4, 00:08:55, Ethernet0
     192.168.4.0/32 is subnetted, 1 subnets
D       192.168.4.4 [90/409600] via 172.16.24.4, 01:37:57, Ethernet0
     192.168.1.0/32 is subnetted, 1 subnets
D       192.168.1.1 [90/437760] via 172.16.24.4, 01:37:15, Ethernet0
     192.168.2.0/32 is subnetted, 1 subnets
C       192.168.2.2 is directly connected, Loopback0
     192.168.3.0/32 is subnetted, 1 subnets
D       192.168.3.3 [90/412160] via 172.16.24.4, 01:34:38, Ethernet0
```

Figure 10

In Figure 10 there is a view of the network from the perspective of cisco-3. Note its configuration includes both EIGRP and OSPF. The routing table includes but does not redistribute both EIGRP and OSPF routes. For a topological view of this network see figure 7.

```
router eigrp 1
 passive-interface GigabitEthernet3/0
 network 172.16.0.0
 network 192.168.3.0
 no auto-summary
!
router ospf 1
 log-adjacency-changes
 network 172.16.31.0 0.0.0.7 area 0.0.0.0

cisco-3# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
D       172.16.42.0/29 [90/30720] via 172.16.34.4, 01:43:26, FastEthernet1/1
C       172.16.34.0/29 is directly connected, FastEthernet1/1
C       172.16.31.0/29 is directly connected, GigabitEthernet3/0
D       172.16.24.0/29 [90/30720] via 172.16.34.4, 01:43:26, FastEthernet1/1
O       172.16.21.0/24 [110/21] via 172.16.31.1, 00:14:35, GigabitEthernet3/0
O       172.16.22.0/24 [110/41] via 172.16.31.1, 00:14:35, GigabitEthernet3/0
D       172.16.12.0/29 [90/2174976] via 172.16.34.4, 01:43:27, FastEthernet1/1
C       172.16.13.0/29 is directly connected, FastEthernet1/0
D       172.16.11.0/24 [90/307200] via 172.16.13.1, 00:12:33, FastEthernet1/0
     192.168.4.0/32 is subnetted, 1 subnets
D       192.168.4.4 [90/156160] via 172.16.34.4, 01:41:35, FastEthernet1/1
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/11] via 172.16.31.1, 00:14:36, GigabitEthernet3/0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/31] via 172.16.31.1, 00:14:36, GigabitEthernet3/0
     192.168.1.0/32 is subnetted, 1 subnets
D       192.168.1.1 [90/409600] via 172.16.13.1, 01:40:53, FastEthernet1/0
     192.168.2.0/32 is subnetted, 1 subnets
D       192.168.2.2 [90/158720] via 172.16.34.4, 01:39:55, FastEthernet1/1
     192.168.3.0/32 is subnetted, 1 subnets
```

```
C       192.168.3.3 is directly connected, Loopback0
```

Figure 11

In Figure 11 there is a view of the network from the perspective of cisco-4 perspective. Note its configuration includes both EIGRP and OSPF. The routing table includes but does not redistribute both EIGRP and OSPF routes. For a topological view of this network see figure 7.

```
router eigrp 1
 passive-interface FastEthernet3/0
 network 172.16.0.0
 network 192.168.4.0
 no auto-summary
 eigrp log-neighbor-changes

router ospf 1
 log-adjacency-changes
 network 172.16.42.0 0.0.0.7 area 0.0.0.0

cisco-4# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set


     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
C       172.16.42.0/29 is directly connected, FastEthernet3/0
C       172.16.34.0/29 is directly connected, FastEthernet4/0
D       172.16.31.0/29 [90/28416] via 172.16.34.3, 01:41:01, FastEthernet4/0
C       172.16.24.0/29 is directly connected, FastEthernet0/0
O       172.16.21.0/24 [110/41] via 172.16.42.2, 00:12:09, FastEthernet3/0
O       172.16.22.0/24 [110/21] via 172.16.42.2, 00:12:09, FastEthernet3/0
D       172.16.12.0/29 [90/2172416] via 172.16.24.2, 01:47:00, FastEthernet0/0
D       172.16.13.0/29 [90/284160] via 172.16.34.3, 01:41:01, FastEthernet4/0
D       172.16.11.0/24 [90/309760] via 172.16.34.3, 00:10:06, FastEthernet4/0
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/31] via 172.16.42.2, 00:12:10, FastEthernet3/0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/11] via 172.16.42.2, 00:12:10, FastEthernet3/0
     192.168.1.0/32 is subnetted, 1 subnets
D       192.168.1.1 [90/412160] via 172.16.34.3, 01:38:27, FastEthernet4/0
     192.168.2.0/32 is subnetted, 1 subnets
D       192.168.2.2 [90/156160] via 172.16.24.2, 01:37:29, FastEthernet0/0
     192.168.3.0/32 is subnetted, 1 subnets
D       192.168.3.3 [90/156160] via 172.16.34.3, 01:35:49, FastEthernet4/0
```

Figure 12

In Figure 12 there is a view of the network from the perspective of RS-1. Note its configuration includes only OSPF and its routing table includes only OSPF routes. For a topological view of this network see figure 7.

```
ip-router global set router-id 192.168.21.1
ospf create area backbone
ospf add interface all to-area backbone
ospf add stub-host 192.168.21.1 to-area backbone cost 10
ospf start

RS-1# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
172.16.12.0/29       directly connected   -         et.1.2
172.16.21.0/24       directly connected   -         LAN
172.16.22.0/24       172.16.12.2          OSPF      et.1.2
172.16.31.0/29       directly connected   -         gi.2.1
172.16.42.0/29       172.16.12.2          OSPF      et.1.2
192.168.21.1         192.168.21.1         -         lo0
192.168.22.2         172.16.12.2          OSPF      et.1.2
```

Figure 13

In Figure 13 there is a view of the network from the perspective of RS-2. Note its configuration includes only OSPF and its routing table includes only OSPF routes. For a topological view of this network see figure 7.

```
interface add ip lo0 address-netmask 192.168.22.2/32
ip-router global set router-id 192.168.22.2
ospf create area backbone
ospf add interface all to-area backbone
ospf add stub-host 192.168.22.2 to-area backbone cost 10
ospf start

RS-2# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
172.16.12.0/29       directly connected   -         et.1.2
172.16.21.0/24       172.16.12.1          OSPF      et.1.2
172.16.22.0/24       directly connected   -         LAN
172.16.31.0/29       172.16.12.1          OSPF      et.1.2
172.16.42.0/29       directly connected   -         et.1.1
192.168.21.1         172.16.12.1          OSPF      et.1.2
192.168.22.2         192.168.22.2         -         lo0
```

Route-Redistribution Scenario

Now with a thorough understanding of the network the first migration scenario shown will be route-redistribution. In this strategy the configurations will change only for routers cisco-3 and cisco-4. This is considered this scenarios largest benefit. All other routers will have full reachability information via their native protocol. Therefore the pertinent configurations will be shown on routers cisco-3 and cisco-4. Additionally, we will show the routing tables from cisco-1 and RS-1. The routing tables from cisco-1 and RS-1 will show that OSPF routes are learned as EIGRP external routes in the EIGRP domain. EIGRP routes are learned as OSPF autonomous system external routes in the OSPF domain.

Figure 14

In Figure 14 there is a conceptual view of the route redistribution scenario.

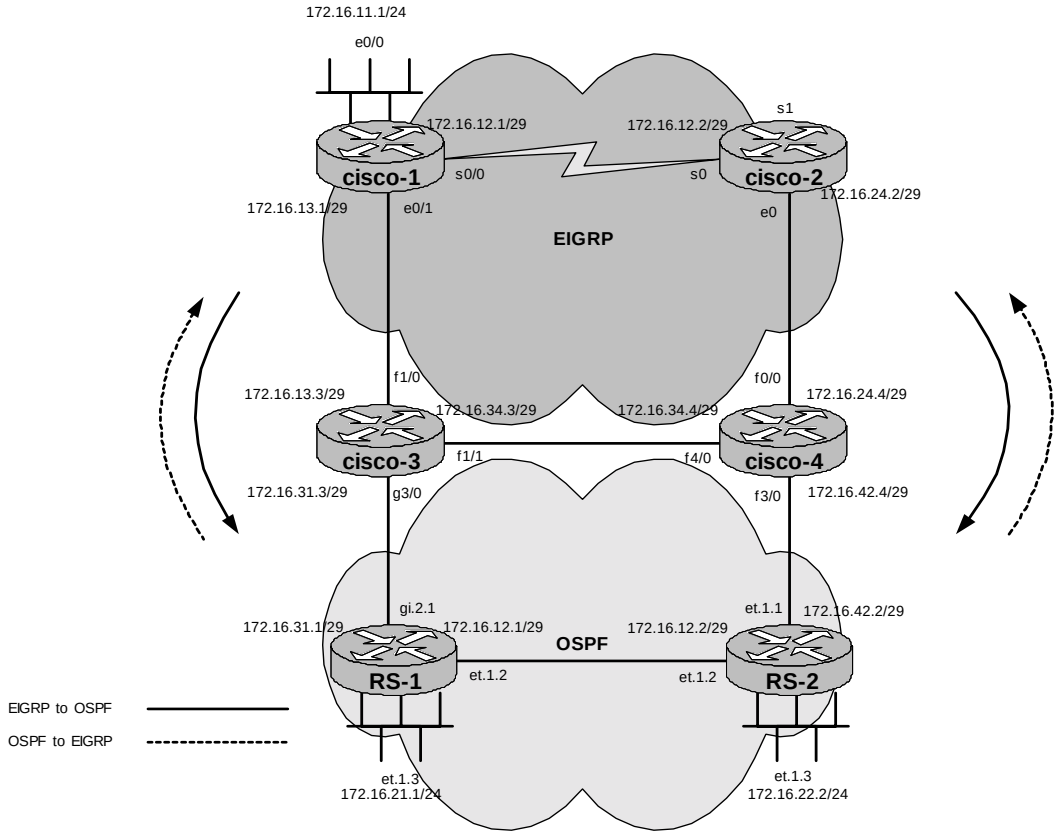


Figure 15

In Figure 15 the pertinent configuration of the routers performing the route-redistribution is shown. As stated in the first part of this document, route redistribution introduces the potential for routing loops. Therefore if route redistribution is to be deployed it is highly recommended that some kind of filtering be put in place to prevent route feedback. This type of filtering could be distribute-lists, route-maps, route-tagging or some other type of export policy. Regardless of the method used it is highly recommended to configure filtering redistribution points. Note in our example we have used distribute-lists. Looking at the syntax it is noted that the distribute list allows for all EIGRP routes to be injected into the OSPF domain. OSPF routes are permitted to be injected in the EIGRP domain. All other routes are blocked. If additional subnets are to be introduced into either the EIGRP or OSPF domain it will be necessary to adjust the access-list accordingly. The necessity for frequent adjustment of access-lists on non-stagnant networks makes this a highly administrative burden.

Redistribution Configurations at Boundary points

Routers cisco-3 and cisco-4:

```
router eigrp 1
 redistribute ospf 1
 default-metric 1500 2000 255 1 1500
 distribute-list 1 out ospf 1
 no auto-summary
!
router ospf 1
 log-adjacency-changes
 redistribute eigrp 1 subnets
 default-metric 100
 distribute-list 2 out eigrp 1

!
access-list 1 permit 192.168.21.1
access-list 1 permit 192.168.22.2
access-list 1 permit 172.16.21.0 0.0.0.255
access-list 1 permit 172.16.22.0 0.0.0.255
access-list 1 permit 172.16.31.0 0.0.0.7
access-list 2 permit 192.168.4.4
access-list 2 permit 192.168.1.1
access-list 2 permit 192.168.2.2
access-list 2 permit 192.168.3.3
access-list 2 permit 172.16.42.0 0.0.0.7
access-list 2 permit 172.16.24.0 0.0.0.7
access-list 2 permit 172.16.12.0 0.0.0.7
access-list 2 permit 172.16.11.0 0.0.0.255
access-list 2 permit 172.16.13.0 0.0.0.7
access-list 2 permit 172.16.31.0 0.0.0.7
access-list 2 permit 172.16.34.0 0.0.0.7
```

Figure 16

In Figure 16 there is a view of the routing table from the perspective of cisco-1. All native EIGRP routes appear as EIGRP routes. The routes from the OSPF domain appear as EIGRP external routes. Note the “D EX” in the routing table for EIGRP external routes.

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

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 8 subnets, 2 masks
D EX    172.16.42.0/29 [170/2244096] via 172.16.13.3, 00:31:24, Ethernet0/1
D       172.16.31.0/29 [90/281856] via 172.16.13.3, 00:40:48, Ethernet0/1
D       172.16.34.0/29 [90/284160] via 172.16.13.3, 01:45:48, Ethernet0/1
D       172.16.24.0/29 [90/2195456] via 172.16.12.2, 00:52:23, Serial0/0
D EX    172.16.21.0/24 [170/2244096] via 172.16.13.3, 00:31:24, Ethernet0/1
D EX    172.16.22.0/24 [170/2244096] via 172.16.13.3, 00:31:24, Ethernet0/1
C       172.16.12.0/29 is directly connected, Serial0/0
C       172.16.13.0/29 is directly connected, Ethernet0/1
C       172.16.11.0/24 is directly connected, Ethernet0/0
     192.168.4.0/32 is subnetted, 1 subnets
D     192.168.4.4 [90/2244096] via 172.16.13.3, 00:31:25, Ethernet0/1
      192.168.21.0/32 is subnetted, 1 subnets
D  EX 192.168.21.1 [170/2244096] via 172.16.13.3, 00:31:25, Ethernet0/1
     192.168.22.0/32 is subnetted, 1 subnets
D EX    192.168.22.2 [170/2244096] via 172.16.13.3, 00:31:25, Ethernet0/1
     192.168.1.0/32 is subnetted, 1 subnets
C       192.168.1.1 is directly connected, Loopback0
     192.168.2.0/32 is subnetted, 1 subnets
D       192.168.2.2 [90/2297856] via 172.16.12.2, 00:52:24, Serial0/0
     192.168.3.0/32 is subnetted, 1 subnets
D    192.168.3.3 [90/281856] via 172.16.13.3, 00:40:48, Ethernet0/1
```

Figure 17

In Figure 17 there is a view of the routing table from the perspective of RS-1. All native OSPF routes appear as OSPF routes. The routes from the EIGRP domain appear as autonomous system external routes notes by the “OSPF_ASE” in the routing table.

```
RS-1# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
172.16.11.0/24        172.16.31.3          OSPF_ASE  gi.2.1
172.16.12.0/29       directly connected   -         et.1.2
172.16.13.0/29       172.16.31.3          OSPF_ASE  gi.2.1
172.16.21.0/24       directly connected   -         LAN
172.16.22.0/24       172.16.12.2          OSPF      et.1.2
172.16.24.0/29       172.16.31.3          OSPF_ASE  gi.2.1
172.16.31.0/29       directly connected   -         gi.2.1
172.16.34.0/29       172.16.31.3          OSPF      gi.2.1
172.16.42.0/29       172.16.12.2          OSPF      et.1.2
192.168.1.1          172.16.31.3          OSPF_ASE  gi.2.1
```

```
192.168.2.2          172.16.31.3          OSPF_ASE  gi.2.1
192.168.3.3          172.16.31.3          OSPF_ASE  gi.2.1
192.168.4.4          172.16.12.2          OSPF_ASE  et.1.2
192.168.21.1         192.168.21.1         -         lo0
192.168.22.2         172.16.12.2          OSPF      et.1.2
```

Routing Protocol Migration

As mentioned in the above passages the recommended approach is a full migration to OSPF. This is the most scaleable method and it offers the least risk.

This example will show a full routing protocol migration. Full configurations can be seen in appendix B and C.

The network used for the migration is the same network as used for the above EIGRP to OSPF redistribution strategy. It will be shown again to assist the reader in Figure 18.

This process as described in the theoretical section of this paper will require running EIGRP and OSPF in the EIGRP domain concurrently. Given that both protocols are running the routing protocol with the lowest administrative distance will populate the routing table. Cisco routers give EIGRP learned routes an administrative distance of 90 and OSPF learned routes and administrative distance of 110, therefore the EIGRP learned routes will appear in the routing tables and not the OSPF routes. This makes the routing migration very simple. Add OSPF to all EIGRP speaking routers verify the OSPF routing information and then simply remove EIGRP.

The steps required for route migration can be summarized below.

1. Baseline the network.
2. Configure both routing protocols concurrently.
3. Verify the subnets are present inside of the OSPF protocol.
4. Remove EIGRP
5. Test connectivity.

Figure 18

This is the network topology used for the routing protocol migration.

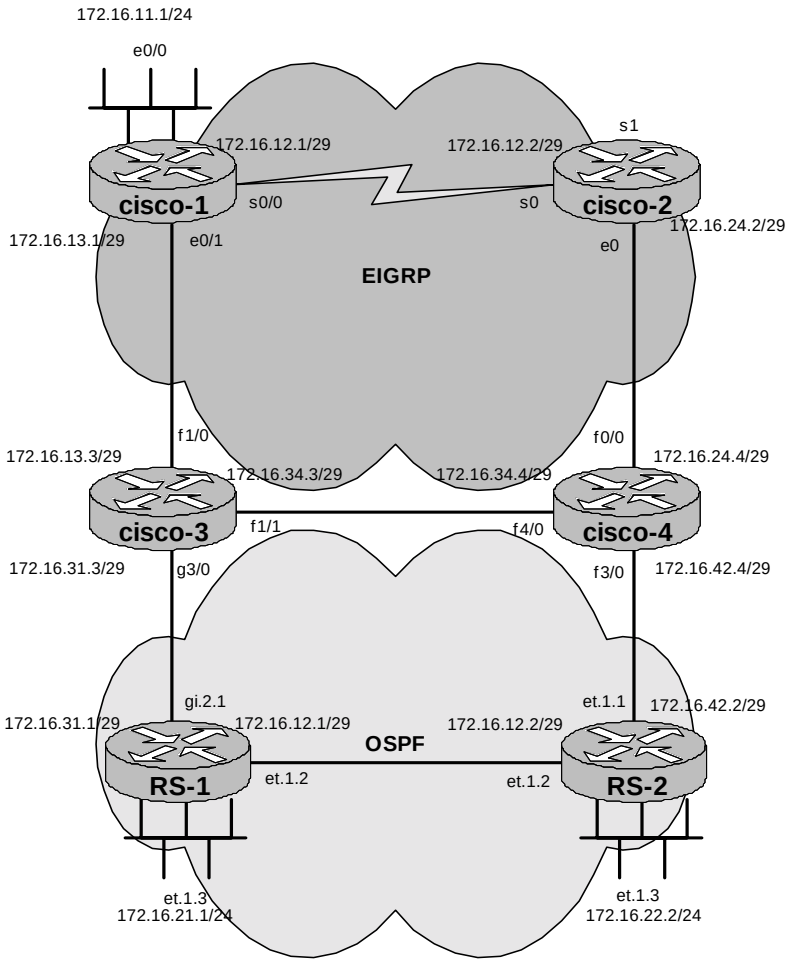


Figure 19

In Figure 19 there is a view of the pertinent routing configurations and the routing table from the cisco-1 perspective. Note that as mentioned above due to EIGRP's administrative distance when both EIGRP and OSPF routes exist for the same subnet, only the EIGRP routers are displayed in the routing table.

```
cisco-1#

router eigrp 1
 network 172.16.0.0
 network 192.168.1.0
 no auto-summary
 eigrp log-neighbor-changes
!
router ospf 1
 log-adjacency-changes
 network 172.16.11.0 0.0.0.255 area 0.0.0.0
 network 172.16.12.0 0.0.0.7 area 0.0.0.0
 network 172.16.13.0 0.0.0.7 area 0.0.0.0
 network 192.168.1.1 0.0.0.0 area 0.0.0.0

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

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
D       172.16.42.0/29 [90/286720] via 172.16.13.3, 00:19:25, Ethernet0/1
D       172.16.34.0/29 [90/284160] via 172.16.13.3, 00:19:25, Ethernet0/1
D       172.16.31.0/29 [90/281856] via 172.16.13.3, 00:19:22, Ethernet0/1
D       172.16.24.0/29 [90/286720] via 172.16.13.3, 00:19:26, Ethernet0/1
O       172.16.21.0/24 [110/31] via 172.16.13.3, 00:03:25, Ethernet0/1
O       172.16.22.0/24 [110/32] via 172.16.13.3, 00:03:25, Ethernet0/1
C       172.16.12.0/29 is directly connected, Serial0/0
C       172.16.13.0/29 is directly connected, Ethernet0/1
C       172.16.11.0/24 is directly connected, Ethernet0/0
     192.168.4.0/32 is subnetted, 1 subnets
D       192.168.4.4 [90/412160] via 172.16.13.3, 00:19:25, Ethernet0/1
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/21] via 172.16.13.3, 00:03:26, Ethernet0/1
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/22] via 172.16.13.3, 00:03:26, Ethernet0/1
     192.168.1.0/32 is subnetted, 1 subnets
C       192.168.1.1 is directly connected, Loopback0
     192.168.2.0/32 is subnetted, 1 subnets
D       192.168.2.2 [90/414720] via 172.16.13.3, 00:19:27, Ethernet0/1
     192.168.3.0/32 is subnetted, 1 subnets
D       192.168.3.3 [90/409600] via 172.16.13.3, 00:19:23, Ethernet0/1
```

Figure 20

In Figure 20 there is a view of the LSA database from the perspective of cisco-1. Since OSPF routes do not populate the routing table due to EIGRP's administrative distance it is necessary to view the LSA database of the routers before removing EIGRP. This needs to be performed on all routers in the domain before removing EIGRP in order to verify that all networks are present in the OSPF routing domain first. Since the above network is in a single area and all routers in an area have identical link state databases, the LSA database is shown only from the perspective of cisco-1.

```
cisco-1#show ip ospf database

            OSPF Router with ID (192.168.1.1) (Process ID 1)

                Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
192.168.1.1     192.168.1.1     525         0x80000006 0x903A   5
192.168.2.2     192.168.2.2     525         0x80000004 0x4028   4
192.168.3.3     192.168.3.3     778         0x80000010 0xF28F   4
192.168.4.4     192.168.4.4     1334        0x8000000F 0x8C89   3
192.168.21.1    192.168.21.1    913         0x8000000E 0x68DC   4
192.168.22.2    192.168.22.2    1071        0x8000000C 0xD08    4

                Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum
172.16.12.2     192.168.22.2    1551        0x8000000A 0x2AE0
172.16.13.3     192.168.3.3     779         0x80000001 0x1E0C
172.16.31.1     192.168.21.1    1093        0x8000000A 0x8D7F
172.16.34.3     192.168.3.3     430         0x80000002 0x8588
172.16.42.2     192.168.22.2    951         0x8000000A 0x2BCF

                Summary Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum
172.16.24.0     192.168.4.4     1324        0x80000001 0x9A62
```

Figure 21

In Figure 21 there is another way of verifying the OSPF routing is fully functional. From a router in the OSPF only domain verify the connectivity and routing information into the EIGRP domain.

```
RS-1# show running-config
Running system configuration:
     !
     ! Last modified from Console on 2003-03-10 15:10:27
     !
 1 : interface create ip gi.2.1 address-netmask 172.16.31.1/29 port gi.2.1
 2 : interface create ip et.1.2 address-netmask 172.16.12.1/29 port et.1.2
 3 : interface create ip LAN address-netmask 172.16.21.1/24 port et.1.3
 4 : interface add ip lo0 address-netmask 192.168.21.1/32
     !
 5 : ip-router global set router-id 192.168.21.1
     !
 6 : ospf create area backbone
 7 : ospf add interface all to-area backbone
 8 : ospf add stub-host 192.168.21.1 to-area backbone cost 10
 9 : ospf start
```

```
     !
10 : system set name RS-1

RS-1# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
172.16.11.0/24        172.16.31.3          OSPF      gi.2.1
172.16.12.0/29       directly connected   -         et.1.2
172.16.13.0/29       172.16.31.3          OSPF      gi.2.1
172.16.21.0/24       directly connected   -         LAN
172.16.22.0/24       172.16.31.3          OSPF      gi.2.1
172.16.24.0/29       172.16.31.3          OSPF_IA   gi.2.1
172.16.31.0/29       directly connected   -         gi.2.1
172.16.34.0/29       172.16.31.3          OSPF      gi.2.1
172.16.42.0/29       172.16.31.3          OSPF      gi.2.1
192.168.1.1          172.16.31.3          OSPF      gi.2.1
192.168.2.2          172.16.31.3          OSPF      gi.2.1
192.168.3.3          172.16.31.3          OSPF      gi.2.1
192.168.4.4          172.16.31.3          OSPF      gi.2.1
192.168.21.1         192.168.21.1         -         lo0
192.168.22.2         172.16.31.3          OSPF      gi.2.1
```

Since routing has been verified through the network the EIGRP configurations will be removed. The pertinent routing configurations will be shown in the below figures.

Figure 22

In Figure 22 the EIGRP configuration has been removed. Pertinent routing configurations and routing tables are shown from the perspective of cisco-1.

```
router ospf 1
 log-adjacency-changes
 network 172.16.11.0 0.0.0.255 area 0.0.0.0
 network 172.16.12.0 0.0.0.7 area 0.0.0.0
 network 172.16.13.0 0.0.0.7 area 0.0.0.0
 network 192.168.1.1 0.0.0.0 area 0.0.0.0

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

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
O       172.16.42.0/29 [110/12] via 172.16.13.3, 00:04:45, Ethernet0/1
O       172.16.34.0/29 [110/11] via 172.16.13.3, 00:04:45, Ethernet0/1
O       172.16.31.0/29 [110/11] via 172.16.13.3, 00:04:46, Ethernet0/1
O       172.16.24.0/29 [110/12] via 172.16.13.3, 00:04:45, Ethernet0/1
O       172.16.21.0/24 [110/31] via 172.16.13.3, 00:04:46, Ethernet0/1
O       172.16.22.0/24 [110/32] via 172.16.13.3, 00:04:46, Ethernet0/1
C       172.16.12.0/29 is directly connected, Serial0/0
C       172.16.13.0/29 is directly connected, Ethernet0/1
C       172.16.11.0/24 is directly connected, Ethernet0/0
     192.168.4.0/32 is subnetted, 1 subnets
O       192.168.4.4 [110/12] via 172.16.13.3, 00:04:46, Ethernet0/1
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/21] via 172.16.13.3, 00:04:47, Ethernet0/1
```

```
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/22] via 172.16.13.3, 00:04:47, Ethernet0/1
     192.168.1.0/32 is subnetted, 1 subnets
C       192.168.1.1 is directly connected, Loopback0
     192.168.2.0/32 is subnetted, 1 subnets
O       192.168.2.2 [110/13] via 172.16.13.3, 00:04:47, Ethernet0/1
     192.168.3.0/32 is subnetted, 1 subnets
O       192.168.3.3 [110/11] via 172.16.13.3, 00:04:47, Ethernet0/1
```

Figure 23

In Figure 23 the EIGRP configuration has been removed. Pertinent routing configurations and routing tables are shown from the perspective of cisco-2.

```
router ospf 1
 log-adjacency-changes
 network 172.16.12.2 0.0.0.0 area 0.0.0.0
 network 172.16.24.0 0.0.0.7 area 0.0.0.0
 network 192.168.2.2 0.0.0.0 area 0.0.0.0

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

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
O       172.16.42.0/29 [110/11] via 172.16.24.4, 00:11:37, Ethernet0
O       172.16.34.0/29 [110/11] via 172.16.24.4, 00:11:37, Ethernet0
O       172.16.31.0/29 [110/12] via 172.16.24.4, 00:11:37, Ethernet0
C       172.16.24.0/29 is directly connected, Ethernet0
O       172.16.21.0/24 [110/32] via 172.16.24.4, 00:11:37, Ethernet0
O       172.16.22.0/24 [110/31] via 172.16.24.4, 00:11:37, Ethernet0
C       172.16.12.0/29 is directly connected, Serial0
O       172.16.13.0/29 [110/21] via 172.16.24.4, 00:11:37, Ethernet0
O       172.16.11.0/24 [110/31] via 172.16.24.4, 00:11:37, Ethernet0
     192.168.4.0/32 is subnetted, 1 subnets
O       192.168.4.4 [110/11] via 172.16.24.4, 00:11:37, Ethernet0
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/22] via 172.16.24.4, 00:11:37, Ethernet0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/21] via 172.16.24.4, 00:11:38, Ethernet0
     192.168.1.0/32 is subnetted, 1 subnets
O       192.168.1.1 [110/22] via 172.16.24.4, 00:11:38, Ethernet0
     192.168.2.0/32 is subnetted, 1 subnets
C       192.168.2.2 is directly connected, Loopback0
     192.168.3.0/32 is subnetted, 1 subnets
O       192.168.3.3 [110/12] via 172.16.24.4, 00:11:38, Ethernet0
```

Figure 24

In Figure 24 the EIGRP configuration has been removed. Pertinent routing configurations and routing tables are shown from the perspective of cisco-3.

```
router ospf 1
 log-adjacency-changes
 network 172.16.13.0 0.0.0.7 area 0.0.0.0
 network 172.16.31.0 0.0.0.7 area 0.0.0.0
 network 172.16.34.0 0.0.0.3 area 0.0.0.0
```

```
 network 172.16.34.0 0.0.0.7 area 0.0.0.0
 network 192.168.3.3 0.0.0.0 area 0.0.0.0

cisco-3#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
O       172.16.42.0/29 [110/2] via 172.16.34.4, 00:09:40, FastEthernet1/1
C       172.16.34.0/29 is directly connected, FastEthernet1/1
C       172.16.31.0/29 is directly connected, GigabitEthernet3/0
O       172.16.24.0/29 [110/2] via 172.16.34.4, 00:09:40, FastEthernet1/1
O       172.16.21.0/24 [110/21] via 172.16.31.1, 00:09:40, GigabitEthernet3/0
O       172.16.22.0/24 [110/22] via 172.16.34.4, 00:09:40, FastEthernet1/1
O       172.16.12.0/29 [110/21] via 172.16.31.1, 00:09:40, GigabitEthernet3/0
C       172.16.13.0/29 is directly connected, FastEthernet1/0
O       172.16.11.0/24 [110/20] via 172.16.13.1, 00:09:40, FastEthernet1/0
     192.168.4.0/32 is subnetted, 1 subnets
O       192.168.4.4 [110/2] via 172.16.34.4, 00:09:40, FastEthernet1/1
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/11] via 172.16.31.1, 00:09:40, GigabitEthernet3/0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/12] via 172.16.34.4, 00:09:40, FastEthernet1/1
     192.168.1.0/32 is subnetted, 1 subnets
O       192.168.1.1 [110/11] via 172.16.13.1, 00:09:40, FastEthernet1/0
     192.168.2.0/32 is subnetted, 1 subnets
O       192.168.2.2 [110/3] via 172.16.34.4, 00:09:40, FastEthernet1/1
     192.168.3.0/32 is subnetted, 1 subnets
C       192.168.3.3 is directly connected, Loopback0
```

Figure 25

In Figure 25 the EIGRP configuration has been removed. Pertinent routing configurations and routing tables are shown from the perspective of cisco-4.

```
router ospf 1
 log-adjacency-changes
 network 172.16.24.0 0.0.0.7 area 0.0.0.0
 network 172.16.34.0 0.0.0.7 area 0.0.0.0
 network 172.16.42.0 0.0.0.7 area 0.0.0.0
 network 192.168.4.4 0.0.0.0 area 0.0.0.0

cisco-4#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
C       172.16.42.0/29 is directly connected, FastEthernet3/0
C       172.16.34.0/29 is directly connected, FastEthernet4/0
O       172.16.31.0/29 [110/2] via 172.16.34.3, 00:00:52, FastEthernet4/0
C       172.16.24.0/29 is directly connected, FastEthernet0/0
O       172.16.21.0/24 [110/22] via 172.16.34.3, 00:00:52, FastEthernet4/0
O       172.16.22.0/24 [110/21] via 172.16.42.2, 00:00:52, FastEthernet3/0
```

```
O       172.16.12.0/29 [110/21] via 172.16.42.2, 00:00:52, FastEthernet3/0
O       172.16.13.0/29 [110/11] via 172.16.34.3, 00:00:52, FastEthernet4/0
O       172.16.11.0/24 [110/21] via 172.16.34.3, 00:00:52, FastEthernet4/0
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/12] via 172.16.34.3, 00:00:54, FastEthernet4/0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/11] via 172.16.42.2, 00:00:54, FastEthernet3/0
     192.168.1.0/32 is subnetted, 1 subnets
O       192.168.1.1 [110/12] via 172.16.34.3, 00:00:54, FastEthernet4/0
     192.168.2.0/32 is subnetted, 1 subnets
O       192.168.2.2 [110/2] via 172.16.24.2, 00:00:54, FastEthernet0/0
     192.168.3.0/32 is subnetted, 1 subnets
O       192.168.3.3 [110/2] via 172.16.34.3, 00:00:54, FastEthernet4/0
```

Figure 26

In Figure 26 the pertinent routing configurations and routing table are shown from the perspective of RS-1.

```
ip-router global set router-id 192.168.21.1
ospf create area backbone
ospf add interface all to-area backbone
ospf add stub-host 192.168.21.1 to-area backbone cost 10
ospf start

RS-1# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
172.16.11.0/24        172.16.31.3          OSPF      gi.2.1
172.16.12.0/29       directly connected   -         et.1.2
172.16.13.0/29       172.16.31.3          OSPF      gi.2.1
172.16.21.0/24       directly connected   -         LAN
172.16.22.0/24       172.16.31.3          OSPF      gi.2.1
172.16.24.0/29       172.16.31.3          OSPF      gi.2.1
172.16.31.0/29       directly connected   -         gi.2.1
172.16.34.0/29       172.16.31.3          OSPF      gi.2.1
172.16.42.0/29       172.16.31.3          OSPF      gi.2.1
192.168.1.1          172.16.31.3          OSPF      gi.2.1
192.168.2.2          172.16.31.3          OSPF      gi.2.1
192.168.3.3          172.16.31.3          OSPF      gi.2.1
192.168.4.4          172.16.31.3          OSPF      gi.2.1
192.168.21.1         192.168.21.1         -         lo0
192.168.22.2         172.16.31.3          OSPF      gi.2.1
```

Figure 27

In Figure 27 the pertinent routing configurations and routing table are shown from the perspective of RS-2.

```
ip-router global set router-id 192.168.22.2
ospf create area backbone
ospf add interface all to-area backbone
ospf add stub-host 192.168.22.2 to-area backbone cost 10
ospf start

RS-2# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
```

```
172.16.11.0/24       172.16.42.4          OSPF      et.1.1
172.16.12.0/29       directly connected   -         et.1.2
172.16.13.0/29       172.16.42.4          OSPF      et.1.1
172.16.21.0/24       172.16.12.1          OSPF      et.1.2
172.16.22.0/24       directly connected   -         LAN
172.16.24.0/29       172.16.42.4          OSPF_IA   et.1.1
172.16.31.0/29       172.16.12.1          OSPF      et.1.2
                     172.16.42.4          OSPF      et.1.1
172.16.34.0/29       172.16.42.4          OSPF      et.1.1
172.16.42.0/29       directly connected   -         et.1.1
192.168.1.1          172.16.42.4          OSPF      et.1.1
192.168.2.2          172.16.42.4          OSPF      et.1.1
192.168.3.3          172.16.42.4          OSPF      et.1.1
192.168.4.4          172.16.42.4          OSPF      et.1.1
192.168.21.1         172.16.12.1          OSPF      et.1.2
192.168.22.2         192.168.22.2         -         lo0
```

Summary

Link state protocols are the most scaleable routing protocols available. Link State protocols are standards based allowing the network designer to choose best of breed architectures. Finally link state protocols are required for new and advanced features like MPLS traffic engineering.

There are many networks running legacy proprietary distance vector protocols. Interoperability strategies were shown between EIGRP and OSPF. Finally this paper has shown how to migrate from EIGRP to an OSPF network.

Appendix A

This section includes full configurations from the baseline network from Figures 7 to 13.

```
cisco-1#show running-config
Building configuration...

Current configuration : 1008 bytes
!
version 12.2
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname cisco-1
!
logging rate-limit console 10 except errors
enable password labuser
!
ip subnet-zero
!
!
no ip finger
!
ip audit notify log
ip audit po max-events 100
no ip dhcp-client network-discovery
!
call rsvp-sync
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.1.1 255.255.255.255
!
interface Ethernet0/0
 ip address 172.16.11.1 255.255.255.0
 no keepalive
 half-duplex
!
interface Serial0/0
 ip address 172.16.12.1 255.255.255.248
!
interface Ethernet0/1
 ip address 172.16.13.1 255.255.255.248
 half-duplex
!
router eigrp 1
 network 172.16.0.0
 network 192.168.1.0
 no auto-summary
 eigrp log-neighbor-changes
!
ip kerberos source-interface any
ip classless
ip http server
!
!
!
dial-peer cor custom
!
```

```
!
!
!
!
line con 0
 transport input none
line aux 0
line vty 0 4
 password labuser
 login
line vty 5 15
 login
!
no scheduler allocate
end

cisco-2#show running-config
Building configuration...

Current configuration : 697 bytes
!
version 12.1
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname cisco-2
!
enable password labuser
!
!
!
!
!
ip subnet-zero
no ip finger
!
!
!
interface Loopback0
 ip address 192.168.2.2 255.255.255.255
!
interface Ethernet0
 ip address 172.16.24.2 255.255.255.248
!
interface Serial0
 ip address 172.16.12.2 255.255.255.248
!
interface Serial1
 no ip address
 loopback
!
interface BRI0
 no ip address
 shutdown
!
router eigrp 1
 network 172.16.0.0
 network 192.168.2.0
 no auto-summary
 eigrp log-neighbor-changes
!
ip classless
no ip http server
!
!
!
line con 0
 transport input none
line aux 0
```

```
line vty 0 4
 password labuser
 login
!
end

cisco-3#show running-config
Building configuration...

Current configuration : 943 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname "cisco-3"
!
enable password labuser
!
ip subnet-zero
ip cef
!
!
!
call rsvp-sync
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.3.3 255.255.255.255
!
interface FastEthernet0/0
 no ip address
 shutdown
 duplex half
!
interface FastEthernet1/0
 ip address 172.16.13.3 255.255.255.248
 duplex half
 speed 10
!
interface FastEthernet1/1
 ip address 172.16.34.3 255.255.255.248
 duplex full
 speed 100
!
interface GigabitEthernet3/0
 ip address 172.16.31.3 255.255.255.248
 negotiation auto
!
router eigrp 1
 passive-interface GigabitEthernet3/0
 network 172.16.0.0
 network 192.168.3.0
 no auto-summary
!
router ospf 1
 log-adjacency-changes
 network 172.16.31.0 0.0.0.7 area 0.0.0.0
!
ip classless
no ip http server
!
!
```

```
!
dial-peer cor custom
!
!
!
!
line con 0
line aux 0
line vty 0 4
 password labuser
 login
!
end

cisco-4#show running-config
Building configuration...

Current configuration : 883 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname cisco-4
!
enable password labuser
!
ip subnet-zero
!
!
!
call rsvp-sync
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.4.4 255.255.255.255
!
interface FastEthernet0/0
 ip address 172.16.24.4 255.255.255.248
 duplex half
!
interface FastEthernet3/0
 ip address 172.16.42.4 255.255.255.248
 duplex full
!
interface FastEthernet4/0
 ip address 172.16.34.4 255.255.255.248
 duplex full
!
router eigrp 1
 passive-interface FastEthernet3/0
 network 172.16.0.0
 network 192.168.4.0
 no auto-summary
 eigrp log-neighbor-changes
!
router ospf 1
 log-adjacency-changes
 network 172.16.42.0 0.0.0.7 area 0.0.0.0
!
ip classless
no ip http server
!
```

```
!
!
!
gatekeeper
 shutdown
!
!
line con 0
line aux 0
line vty 0 4
 password labuser
 login
line vty 5 15
 login
!
end

RS-2# show running-config
Running system configuration:
     !
     ! Last modified from Console on 2003-03-10 15:06:38
     !
 1 : port set et.1.1 duplex full speed 100mbps
     !
 2 : interface create ip et.1.1 address-netmask 172.16.42.2/29 port et.1.1
 3 : interface create ip et.1.2 address-netmask 172.16.12.2/29 port et.1.2
 4 : interface create ip LAN address-netmask 172.16.22.2/24 port et.1.3
 5 : interface add ip lo0 address-netmask 192.168.22.2/32
     !
 6 : ip-router global set router-id 192.168.22.2
     !
 7 : ospf create area backbone
 8 : ospf add interface all to-area backbone
 9 : ospf add stub-host 192.168.22.2 to-area backbone cost 10
10 : ospf start
     !
11 : system set name RS-2

RS-1# show running-config
Running system configuration:
     !
     ! Last modified from Console on 2003-03-10 15:10:27
     !
 1 : interface create ip gi.2.1 address-netmask 172.16.31.1/29 port gi.2.1
 2 : interface create ip et.1.2 address-netmask 172.16.12.1/29 port et.1.2
 3 : interface create ip LAN address-netmask 172.16.21.1/24 port et.1.3
 4 : interface add ip lo0 address-netmask 192.168.21.1/32
     !
 5 : ip-router global set router-id 192.168.21.1
     !
 6 : ospf create area backbone
 7 : ospf add interface all to-area backbone
 8 : ospf add stub-host 192.168.21.1 to-area backbone cost 10
 9 : ospf start
     !
10 : system set name RS-1
```

Appendix B

Route migration configuration, routing tables and OSPF databases for EIGRP to OSPF migration example. This includes figures 18 through 21.

```
cisco-1#show run
Building configuration...

Current configuration : 1216 bytes
!
version 12.2
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname cisco-1
!
logging rate-limit console 10 except errors
enable password labuser
!
ip subnet-zero
!
!
no ip finger
!
ip audit notify log
ip audit po max-events 100
no ip dhcp-client network-discovery
!
call rsvp-sync
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.1.1 255.255.255.255
!
interface Ethernet0/0
 ip address 172.16.11.1 255.255.255.0
 no keepalive
 half-duplex
!
interface Serial0/0
 ip address 172.16.12.1 255.255.255.248
!
interface Ethernet0/1
 ip address 172.16.13.1 255.255.255.248
 half-duplex
!
router eigrp 1
 network 172.16.0.0
 network 192.168.1.0
 no auto-summary
 eigrp log-neighbor-changes
!
router ospf 1
 log-adjacency-changes
 network 172.16.11.0 0.0.0.255 area 0.0.0.0
 network 172.16.12.0 0.0.0.7 area 0.0.0.0
 network 172.16.13.0 0.0.0.7 area 0.0.0.0
 network 192.168.1.1 0.0.0.0 area 0.0.0.0
!
ip kerberos source-interface any
```

```
ip classless
ip http server
!
!
!
dial-peer cor custom
!
!
!
!
!
line con 0
 transport input none
line aux 0
line vty 0 4
 password labuser
 login
line vty 5 15
 login
!
no scheduler allocate
end

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

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
D       172.16.42.0/29 [90/286720] via 172.16.13.3, 00:32:13, Ethernet0/1
D       172.16.34.0/29 [90/284160] via 172.16.13.3, 00:32:13, Ethernet0/1
D       172.16.31.0/29 [90/281856] via 172.16.13.3, 00:32:10, Ethernet0/1
D       172.16.24.0/29 [90/286720] via 172.16.13.3, 00:32:14, Ethernet0/1
O       172.16.21.0/24 [110/31] via 172.16.13.3, 00:16:13, Ethernet0/1
O       172.16.22.0/24 [110/32] via 172.16.13.3, 00:16:13, Ethernet0/1
C       172.16.12.0/29 is directly connected, Serial0/0
C       172.16.13.0/29 is directly connected, Ethernet0/1
C       172.16.11.0/24 is directly connected, Ethernet0/0
     192.168.4.0/32 is subnetted, 1 subnets
D       192.168.4.4 [90/412160] via 172.16.13.3, 00:32:13, Ethernet0/1
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/21] via 172.16.13.3, 00:16:13, Ethernet0/1
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/22] via 172.16.13.3, 00:16:14, Ethernet0/1
     192.168.1.0/32 is subnetted, 1 subnets
C       192.168.1.1 is directly connected, Loopback0
     192.168.2.0/32 is subnetted, 1 subnets
D       192.168.2.2 [90/414720] via 172.16.13.3, 00:32:15, Ethernet0/1
     192.168.3.0/32 is subnetted, 1 subnets
D       192.168.3.3 [90/409600] via 172.16.13.3, 00:32:11, Ethernet0/1

cisco-1#show ip ospf database

            OSPF Router with ID (192.168.1.1) (Process ID 1)

                Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
192.168.1.1     192.168.1.1     994         0x80000006 0x903A   5
192.168.2.2     192.168.2.2     995         0x80000004 0x4028   4
192.168.3.3     192.168.3.3     1248        0x80000010 0xF28F   4
192.168.4.4     192.168.4.4     1803        0x8000000F 0x8C89   3
192.168.21.1    192.168.21.1    1382        0x8000000E 0x68DC   4
192.168.22.2    192.168.22.2    1540        0x8000000C 0xD08    4
```

```
                Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum
172.16.12.2     192.168.22.2    161         0x8000000B 0x28E1
172.16.13.3     192.168.3.3     1249        0x80000001 0x1E0C
172.16.31.1     192.168.21.1    1562        0x8000000A 0x8D7F
172.16.34.3     192.168.3.3     900         0x80000002 0x8588
172.16.42.2     192.168.22.2    1420        0x8000000A 0x2BCF

                Summary Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum
172.16.24.0     192.168.4.4     1793        0x80000001 0x9A62

cisco-2#show running-config
Building configuration...

Current configuration : 862 bytes
!
version 12.1
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname cisco-2
!
enable password labuser
!
!
!
!
!
ip subnet-zero
no ip finger
!
!
!
interface Loopback0
 ip address 192.168.2.2 255.255.255.255
!
interface Ethernet0
 ip address 172.16.24.2 255.255.255.248
!
interface Serial0
 ip address 172.16.12.2 255.255.255.248
!
interface Serial1
 no ip address
 loopback
!
interface BRI0
 no ip address
 shutdown
!
router eigrp 1
 network 172.16.0.0
 network 192.168.2.0
 no auto-summary
 eigrp log-neighbor-changes
!
router ospf 1
 log-adjacency-changes
 network 172.16.12.2 0.0.0.0 area 0.0.0.0
 network 172.16.24.0 0.0.0.7 area 0.0.0.0
 network 192.168.2.2 0.0.0.0 area 0.0.0.0
!
ip classless
no ip http server
!
```

```
!
!
line con 0
 transport input none
line aux 0
line vty 0 4
 password labuser
 login
!
end

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

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
D       172.16.42.0/29 [90/284160] via 172.16.24.4, 00:33:24, Ethernet0
D       172.16.34.0/29 [90/284160] via 172.16.24.4, 00:33:24, Ethernet0
D       172.16.31.0/29 [90/284416] via 172.16.24.4, 00:33:21, Ethernet0
C       172.16.24.0/29 is directly connected, Ethernet0
O       172.16.21.0/24 [110/95] via 172.16.12.1, 00:17:24, Serial0
O       172.16.22.0/24 [110/96] via 172.16.12.1, 00:17:24, Serial0
C       172.16.12.0/29 is directly connected, Serial0
D       172.16.13.0/29 [90/309760] via 172.16.24.4, 00:33:21, Ethernet0
D       172.16.11.0/24 [90/335360] via 172.16.24.4, 00:33:21, Ethernet0
     192.168.4.0/32 is subnetted, 1 subnets
D       192.168.4.4 [90/409600] via 172.16.24.4, 00:33:24, Ethernet0
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/85] via 172.16.12.1, 00:17:26, Serial0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/86] via 172.16.12.1, 00:17:26, Serial0
     192.168.1.0/32 is subnetted, 1 subnets
D       192.168.1.1 [90/437760] via 172.16.24.4, 00:33:23, Ethernet0
     192.168.2.0/32 is subnetted, 1 subnets
C       192.168.2.2 is directly connected, Loopback0
     192.168.3.0/32 is subnetted, 1 subnets
D       192.168.3.3 [90/412160] via 172.16.24.4, 00:33:23, Ethernet0

cisco-2#show ip ospf database

       OSPF Router with ID (192.168.2.2) (Process ID 1)


                Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
192.168.1.1     192.168.1.1     1070        0x80000006 0x903A   5
192.168.2.2     192.168.2.2     1070        0x80000004 0x4028   4
192.168.3.3     192.168.3.3     1324        0x80000010 0xF28F   4
192.168.4.4     192.168.4.4     1880        0x8000000F 0x8C89   3
192.168.21.1    192.168.21.1    1459        0x8000000E 0x68DC   4
192.168.22.2    192.168.22.2    1617        0x8000000C 0xD08    4

                Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum
172.16.12.2     192.168.22.2    237         0x8000000B 0x28E1
172.16.13.3     192.168.3.3     1325        0x80000001 0x1E0C
172.16.31.1     192.168.21.1    1639        0x8000000A 0x8D7F
172.16.34.3     192.168.3.3     976         0x80000002 0x8588
172.16.42.2     192.168.22.2    1497        0x8000000A 0x2BCF

                Summary Net Link States (Area 0.0.0.0)
```

```
Link ID         ADV Router      Age         Seq#       Checksum
172.16.24.0     192.168.4.4     1870        0x80000001 0x9A62

cisco-3#show running-config
Building configuration...

Current configuration : 1111 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname "cisco-3"
!
enable password labuser
!
ip subnet-zero
ip cef
!
!
!
call rsvp-sync
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.3.3 255.255.255.255
!
interface FastEthernet0/0
 no ip address
 shutdown
 duplex half
!
interface FastEthernet1/0
 ip address 172.16.13.3 255.255.255.248
 duplex half
 speed 10
!
interface FastEthernet1/1
 ip address 172.16.34.3 255.255.255.248
 duplex full
 speed 100
!
interface GigabitEthernet3/0
 ip address 172.16.31.3 255.255.255.248
 negotiation auto
!
router eigrp 1
 passive-interface GigabitEthernet3/0
 network 172.16.0.0
 network 192.168.3.0
 no auto-summary
!
router ospf 1
 log-adjacency-changes
 network 172.16.13.0 0.0.0.7 area 0.0.0.0
 network 172.16.31.0 0.0.0.7 area 0.0.0.0
 network 172.16.34.0 0.0.0.3 area 0.0.0.0
 network 172.16.34.0 0.0.0.7 area 0.0.0.0
 network 192.168.3.3 0.0.0.0 area 0.0.0.0
!
ip classless
no ip http server
!
```

```
!
!
dial-peer cor custom
!
!
!
!
line con 0
line aux 0
line vty 0 4
 password labuser
 login
!
end

cisco-3#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
D       172.16.42.0/29 [90/30720] via 172.16.34.4, 00:34:19, FastEthernet1/1
C       172.16.34.0/29 is directly connected, FastEthernet1/1
C       172.16.31.0/29 is directly connected, GigabitEthernet3/0
D       172.16.24.0/29 [90/30720] via 172.16.34.4, 00:34:19, FastEthernet1/1
O       172.16.21.0/24 [110/21] via 172.16.31.1, 00:18:17, GigabitEthernet3/0
O       172.16.22.0/24 [110/22] via 172.16.34.4, 00:18:17, FastEthernet1/1
D       172.16.12.0/29 [90/2174976] via 172.16.34.4, 00:34:19, FastEthernet1/1
C       172.16.13.0/29 is directly connected, FastEthernet1/0
D       172.16.11.0/24 [90/307200] via 172.16.13.1, 00:36:24, FastEthernet1/0
     192.168.4.0/32 is subnetted, 1 subnets
D       192.168.4.4 [90/156160] via 172.16.34.4, 00:34:19, FastEthernet1/1
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/11] via 172.16.31.1, 00:18:18, GigabitEthernet3/0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/12] via 172.16.34.4, 00:18:18, FastEthernet1/1
     192.168.1.0/32 is subnetted, 1 subnets
D       192.168.1.1 [90/409600] via 172.16.13.1, 00:36:24, FastEthernet1/0
     192.168.2.0/32 is subnetted, 1 subnets
D       192.168.2.2 [90/158720] via 172.16.34.4, 00:34:19, FastEthernet1/1
     192.168.3.0/32 is subnetted, 1 subnets
C       192.168.3.3 is directly connected, Loopback0

cisco-3#show ip ospf database

            OSPF Router with ID (192.168.3.3) (Process ID 1)

                Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
192.168.1.1     192.168.1.1     1118        0x80000006 0x00903A 5
192.168.2.2     192.168.2.2     1118        0x80000004 0x004028 4
192.168.3.3     192.168.3.3     1370        0x80000010 0x00F28F 4
192.168.4.4     192.168.4.4     1925        0x8000000F 0x008C89 3
192.168.21.1    192.168.21.1    1504        0x8000000E 0x0068DC 4
192.168.22.2    192.168.22.2    1662        0x8000000C 0x000D08 4

                Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum
172.16.12.2     192.168.22.2    282         0x8000000B 0x0028E1
172.16.13.3     192.168.3.3     1370        0x80000001 0x001E0C
172.16.31.1     192.168.21.1    1684        0x8000000A 0x008D7F
172.16.34.3     192.168.3.3     1021        0x80000002 0x008588
```

```
172.16.42.2     192.168.22.2    1542        0x8000000A 0x002BCF

                Summary Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum
172.16.24.0     192.168.4.4     1915        0x80000001 0x009A62

cisco-4#show running-config
Building configuration...

Current configuration : 1009 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname cisco-4
!
enable password labuser
!
ip subnet-zero
!
!
!
call rsvp-sync
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.4.4 255.255.255.255
!
interface FastEthernet0/0
 ip address 172.16.24.4 255.255.255.248
 duplex half
!
interface FastEthernet3/0
 ip address 172.16.42.4 255.255.255.248
 duplex full
!
interface FastEthernet4/0
 ip address 172.16.34.4 255.255.255.248
 duplex full
!
router eigrp 1
 passive-interface FastEthernet3/0
 network 172.16.0.0
 network 192.168.4.0
 no auto-summary
 eigrp log-neighbor-changes
!
router ospf 1
 log-adjacency-changes
 network 172.16.24.0 0.0.0.7 area 0.0.0.0
 network 172.16.34.0 0.0.0.7 area 0.0.0.0
 network 172.16.42.0 0.0.0.7 area 0.0.0.0
 network 192.168.4.4 0.0.0.0 area 0.0.0.0
!
ip classless
no ip http server
!
!
!
!
gatekeeper
```

```
 shutdown
!
!
line con 0
line aux 0
line vty 0 4
 password labuser
 login
line vty 5 15
 login
!
end

cisco-4#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
C       172.16.42.0/29 is directly connected, FastEthernet3/0
C       172.16.34.0/29 is directly connected, FastEthernet4/0
D       172.16.31.0/29 [90/28416] via 172.16.34.3, 00:37:17, FastEthernet4/0
C       172.16.24.0/29 is directly connected, FastEthernet0/0
O       172.16.21.0/24 [110/22] via 172.16.34.3, 00:00:33, FastEthernet4/0
O       172.16.22.0/24 [110/21] via 172.16.42.2, 00:00:33, FastEthernet3/0
D       172.16.12.0/29 [90/2172416] via 172.16.24.2, 00:37:21, FastEthernet0/0
D       172.16.13.0/29 [90/284160] via 172.16.34.3, 00:37:17, FastEthernet4/0
D       172.16.11.0/24 [90/309760] via 172.16.34.3, 00:37:17, FastEthernet4/0
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/12] via 172.16.34.3, 00:00:33, FastEthernet4/0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/11] via 172.16.42.2, 00:00:33, FastEthernet3/0
     192.168.1.0/32 is subnetted, 1 subnets
D       192.168.1.1 [90/412160] via 172.16.34.3, 00:37:17, FastEthernet4/0
     192.168.2.0/32 is subnetted, 1 subnets
D       192.168.2.2 [90/156160] via 172.16.24.2, 00:37:22, FastEthernet0/0
     192.168.3.0/32 is subnetted, 1 subnets
D       192.168.3.3 [90/156160] via 172.16.34.3, 00:37:17, FastEthernet4/0

cisco-4#show ip ospf database

            OSPF Router with ID (192.168.4.4) (Process ID 1)

                Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
192.168.1.1     192.168.1.1     1307        0x80000006 0x903A   5
192.168.2.2     192.168.2.2     52          0x80000005 0x7E0A   4
192.168.3.3     192.168.3.3     1559        0x80000010 0xF28F   4
192.168.4.4     192.168.4.4     50          0x80000013 0x84CE   4
192.168.21.1    192.168.21.1    1693        0x8000000E 0x68DC   4
192.168.22.2    192.168.22.2    1850        0x8000000C 0xD08    4

                Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#       Checksum
172.16.12.2     192.168.22.2    470         0x8000000B 0x28E1
172.16.13.3     192.168.3.3     1559        0x80000001 0x1E0C
172.16.24.2     192.168.2.2     52          0x80000001 0xF924
172.16.31.1     192.168.21.1    13          0x8000000B 0x8B80
172.16.34.3     192.168.3.3     1211        0x80000002 0x8588
172.16.42.2     192.168.22.2    1730        0x8000000A 0x2BCF
```

```
RS-1# show running-config
Running system configuration:
     !
     ! Last modified from Console on 2003-03-10 15:10:27
     !
 1 : interface create ip gi.2.1 address-netmask 172.16.31.1/29 port gi.2.1
 2 : interface create ip et.1.2 address-netmask 172.16.12.1/29 port et.1.2
 3 : interface create ip LAN address-netmask 172.16.21.1/24 port et.1.3
 4 : interface add ip lo0 address-netmask 192.168.21.1/32
     !
 5 : ip-router global set router-id 192.168.21.1
     !
 6 : ospf create area backbone
 7 : ospf add interface all to-area backbone
 8 : ospf add stub-host 192.168.21.1 to-area backbone cost 10
 9 : ospf start
     !
10 : system set name RS-1

RS-1# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
172.16.11.0/24        172.16.31.3          OSPF      gi.2.1
172.16.12.0/29       directly connected   -         et.1.2
172.16.13.0/29       172.16.31.3          OSPF      gi.2.1
172.16.21.0/24       directly connected   -         LAN
172.16.22.0/24       172.16.31.3          OSPF      gi.2.1
172.16.24.0/29       172.16.31.3          OSPF_IA   gi.2.1
172.16.31.0/29       directly connected   -         gi.2.1
172.16.34.0/29       172.16.31.3          OSPF      gi.2.1
172.16.42.0/29       172.16.31.3          OSPF      gi.2.1
192.168.1.1          172.16.31.3          OSPF      gi.2.1
192.168.2.2          172.16.31.3          OSPF      gi.2.1
192.168.3.3          172.16.31.3          OSPF      gi.2.1
192.168.4.4          172.16.31.3          OSPF      gi.2.1
192.168.21.1         192.168.21.1         -         lo0
192.168.22.2         172.16.31.3          OSPF      gi.2.1

RS-1# ospf show database

        OSPF Router with ID (192.168.21.1)

ROUTER LSA
            Router Link States (Area: 0.0.0.0)

Link ID         ADV Router      Age  Seq#      Checksum  Cost
-------------------------------------------------------------

192.168.22.2    192.168.22.2    81   8000000d  b09       4

192.168.4.4     192.168.4.4     143  80000013  84ce      3

192.168.2.2     192.168.2.2     145  80000005  7e0a      4

192.168.3.3     192.168.3.3     1650 80000010  f28f      2

192.168.1.1     192.168.1.1     1398 80000006  903a      12

192.168.21.1    192.168.21.1    1782 8000000e  68dc      0


NETWORK LSA
            Net Link States (Area: 0.0.0.0)

Link ID         ADV Router      Age  Seq#      Checksum  Cost
-------------------------------------------------------------

172.16.31.1     192.168.21.1    102  8000000b  8b80      2

172.16.42.2     192.168.22.2    1821 8000000a  2bcf      4
```

```
172.16.24.2     192.168.2.2     145  80000001  f924      4

172.16.12.2     192.168.22.2    561  8000000b  28e1      20

172.16.34.3     192.168.3.3     1301 80000002  8588      3

172.16.13.3     192.168.3.3     1650 80000001  1e0c      12

SUMMARY LSA

ASBR SUMMARY LSA

NSSA EXTERNAL LSA

LINK OPQ LSA

AREA OPQ LSA

AS OPQ LSA

RS-2# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
172.16.11.0/24        172.16.42.4          OSPF      et.1.1
172.16.12.0/29       directly connected   -         et.1.2
172.16.13.0/29       172.16.42.4          OSPF      et.1.1
172.16.21.0/24       172.16.12.1          OSPF      et.1.2
172.16.22.0/24       directly connected   -         LAN
172.16.24.0/29       172.16.42.4          OSPF_IA   et.1.1
172.16.31.0/29       172.16.12.1          OSPF      et.1.2
                     172.16.42.4          OSPF      et.1.1
172.16.34.0/29       172.16.42.4          OSPF      et.1.1
172.16.42.0/29       directly connected   -         et.1.1
192.168.1.1          172.16.42.4          OSPF      et.1.1
192.168.2.2          172.16.42.4          OSPF      et.1.1
192.168.3.3          172.16.42.4          OSPF      et.1.1
192.168.4.4          172.16.42.4          OSPF      et.1.1
192.168.21.1         172.16.12.1          OSPF      et.1.2
192.168.22.2         192.168.22.2         -         lo0

RS-2# ospf show database

        OSPF Router with ID (192.168.22.2)


ROUTER LSA
            Router Link States (Area: 0.0.0.0)

Link ID         ADV Router      Age  Seq#      Checksum  Cost
-------------------------------------------------------------
192.168.21.1    192.168.21.1    1837 8000000e  68dc      20

192.168.4.4     192.168.4.4     196  80000013  84ce      20

192.168.2.2     192.168.2.2     198  80000005  7e0a      21

192.168.22.2    192.168.22.2    133  8000000d  b09       0

192.168.3.3     192.168.3.3     1705 80000010  f28f      21

192.168.1.1     192.168.1.1     1453 80000006  903a      31


NETWORK LSA
            Net Link States (Area: 0.0.0.0)

Link ID         ADV Router      Age  Seq#      Checksum  Cost
```

```
------------------------------------------------------------
172.16.31.1     192.168.21.1    157  8000000b  8b80      22

172.16.42.2     192.168.22.2    13   8000000b  29d0      20

172.16.24.2     192.168.2.2     198  80000001  f924      21

172.16.12.2     192.168.22.2    613  8000000b  28e1      20

172.16.34.3     192.168.3.3     1356 80000002  8588      21

172.16.13.3     192.168.3.3     1705 80000001  1e0c      31

SUMMARY LSA

ASBR SUMMARY LSA

NSSA EXTERNAL LSA

LINK OPQ LSA

AREA OPQ LSA

AS OPQ LSA
```

Appendix C

These configurations and routing tables are from the completed routing protocol migration. This includes figures 22 through 27.

```
cisco-1#show running-config
Building configuration...

Current configuration : 1113 bytes
!
version 12.2
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname cisco-1
!
logging rate-limit console 10 except errors
enable password labuser
!
ip subnet-zero
!
!
no ip finger
!
ip audit notify log
ip audit po max-events 100
no ip dhcp-client network-discovery
!
call rsvp-sync
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.1.1 255.255.255.255
```

```
!
interface Ethernet0/0
 ip address 172.16.11.1 255.255.255.0
 no keepalive
 half-duplex
!
interface Serial0/0
 ip address 172.16.12.1 255.255.255.248
!
interface Ethernet0/1
 ip address 172.16.13.1 255.255.255.248
 half-duplex
!
router ospf 1
 log-adjacency-changes
 network 172.16.11.0 0.0.0.255 area 0.0.0.0
 network 172.16.12.0 0.0.0.7 area 0.0.0.0
 network 172.16.13.0 0.0.0.7 area 0.0.0.0
 network 192.168.1.1 0.0.0.0 area 0.0.0.0
!
ip kerberos source-interface any
ip classless
ip http server
!
!
!
dial-peer cor custom
!
!
!
!
!
line con 0
 transport input none
line aux 0
line vty 0 4
 password labuser
 login
line vty 5 15
 login
!
no scheduler allocate
end

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

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
O       172.16.42.0/29 [110/12] via 172.16.13.3, 00:08:07, Ethernet0/1
O       172.16.34.0/29 [110/11] via 172.16.13.3, 00:08:07, Ethernet0/1
O       172.16.31.0/29 [110/11] via 172.16.13.3, 00:08:07, Ethernet0/1
O       172.16.24.0/29 [110/12] via 172.16.13.3, 00:08:07, Ethernet0/1
O       172.16.21.0/24 [110/31] via 172.16.13.3, 00:08:07, Ethernet0/1
O       172.16.22.0/24 [110/32] via 172.16.13.3, 00:08:07, Ethernet0/1
C       172.16.12.0/29 is directly connected, Serial0/0
C       172.16.13.0/29 is directly connected, Ethernet0/1
C       172.16.11.0/24 is directly connected, Ethernet0/0
     192.168.4.0/32 is subnetted, 1 subnets
O       192.168.4.4 [110/12] via 172.16.13.3, 00:08:07, Ethernet0/1
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/21] via 172.16.13.3, 00:08:07, Ethernet0/1
     192.168.22.0/32 is subnetted, 1 subnets
```

```
O       192.168.22.2 [110/22] via 172.16.13.3, 00:08:07, Ethernet0/1
     192.168.1.0/32 is subnetted, 1 subnets
C       192.168.1.1 is directly connected, Loopback0
     192.168.2.0/32 is subnetted, 1 subnets
O       192.168.2.2 [110/13] via 172.16.13.3, 00:08:07, Ethernet0/1
     192.168.3.0/32 is subnetted, 1 subnets
O       192.168.3.3 [110/11] via 172.16.13.3, 00:08:07, Ethernet0/1

cisco-3#show running-config
Building configuration...

Current configuration : 998 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname "cisco-3"
!
enable password labuser
!
ip subnet-zero
ip cef
!
!
!
call rsvp-sync
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.3.3 255.255.255.255
!
interface FastEthernet0/0
 no ip address
 shutdown
 duplex half
!
interface FastEthernet1/0
 ip address 172.16.13.3 255.255.255.248
 duplex half
 speed 10
!
interface FastEthernet1/1
 ip address 172.16.34.3 255.255.255.248
 duplex full
 speed 100
!
interface GigabitEthernet3/0
 ip address 172.16.31.3 255.255.255.248
 negotiation auto
!
router ospf 1
 log-adjacency-changes
 network 172.16.13.0 0.0.0.7 area 0.0.0.0
 network 172.16.31.0 0.0.0.7 area 0.0.0.0
 network 172.16.34.0 0.0.0.3 area 0.0.0.0
 network 172.16.34.0 0.0.0.7 area 0.0.0.0
 network 192.168.3.3 0.0.0.0 area 0.0.0.0
!
ip classless
no ip http server
!
!
```

```
!
dial-peer cor custom
!
!
!
!
line con 0
line aux 0
line vty 0 4
 password labuser
 login
!
end

cisco-3#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
O       172.16.42.0/29 [110/2] via 172.16.34.4, 00:09:40, FastEthernet1/1
C       172.16.34.0/29 is directly connected, FastEthernet1/1
C       172.16.31.0/29 is directly connected, GigabitEthernet3/0
O       172.16.24.0/29 [110/2] via 172.16.34.4, 00:09:40, FastEthernet1/1
O       172.16.21.0/24 [110/21] via 172.16.31.1, 00:09:40, GigabitEthernet3/0
O       172.16.22.0/24 [110/22] via 172.16.34.4, 00:09:40, FastEthernet1/1
O       172.16.12.0/29 [110/21] via 172.16.31.1, 00:09:40, GigabitEthernet3/0
C       172.16.13.0/29 is directly connected, FastEthernet1/0
O       172.16.11.0/24 [110/20] via 172.16.13.1, 00:09:40, FastEthernet1/0
     192.168.4.0/32 is subnetted, 1 subnets
O       192.168.4.4 [110/2] via 172.16.34.4, 00:09:40, FastEthernet1/1
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/11] via 172.16.31.1, 00:09:40, GigabitEthernet3/0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/12] via 172.16.34.4, 00:09:40, FastEthernet1/1
     192.168.1.0/32 is subnetted, 1 subnets
O       192.168.1.1 [110/11] via 172.16.13.1, 00:09:40, FastEthernet1/0
     192.168.2.0/32 is subnetted, 1 subnets
O       192.168.2.2 [110/3] via 172.16.34.4, 00:09:40, FastEthernet1/1
     192.168.3.0/32 is subnetted, 1 subnets
C       192.168.3.3 is directly connected, Loopback0

cisco-2#show running-config
Building configuration...

Current configuration : 759 bytes
!
version 12.1
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname cisco-2
!
enable password labuser
!
!
!
!
!
ip subnet-zero
no ip finger
!
!
```

```
!
interface Loopback0
 ip address 192.168.2.2 255.255.255.255
!
interface Ethernet0
 ip address 172.16.24.2 255.255.255.248
!
interface Serial0
 ip address 172.16.12.2 255.255.255.248
!
interface Serial1
 no ip address
 loopback
!
interface BRI0
 no ip address
 shutdown
!
router ospf 1
 log-adjacency-changes
 network 172.16.12.2 0.0.0.0 area 0.0.0.0
 network 172.16.24.0 0.0.0.7 area 0.0.0.0
 network 192.168.2.2 0.0.0.0 area 0.0.0.0
!
ip classless
no ip http server
!
!
!
line con 0
 transport input none
line aux 0
line vty 0 4
 password labuser
 login
!
end

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

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
O       172.16.42.0/29 [110/11] via 172.16.24.4, 00:11:37, Ethernet0
O       172.16.34.0/29 [110/11] via 172.16.24.4, 00:11:37, Ethernet0
O       172.16.31.0/29 [110/12] via 172.16.24.4, 00:11:37, Ethernet0
C       172.16.24.0/29 is directly connected, Ethernet0
O       172.16.21.0/24 [110/32] via 172.16.24.4, 00:11:37, Ethernet0
O       172.16.22.0/24 [110/31] via 172.16.24.4, 00:11:37, Ethernet0
C       172.16.12.0/29 is directly connected, Serial0
O       172.16.13.0/29 [110/21] via 172.16.24.4, 00:11:37, Ethernet0
O       172.16.11.0/24 [110/31] via 172.16.24.4, 00:11:37, Ethernet0
     192.168.4.0/32 is subnetted, 1 subnets
O       192.168.4.4 [110/11] via 172.16.24.4, 00:11:37, Ethernet0
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/22] via 172.16.24.4, 00:11:37, Ethernet0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/21] via 172.16.24.4, 00:11:38, Ethernet0
     192.168.1.0/32 is subnetted, 1 subnets
O       192.168.1.1 [110/22] via 172.16.24.4, 00:11:38, Ethernet0
     192.168.2.0/32 is subnetted, 1 subnets
C       192.168.2.2 is directly connected, Loopback0
     192.168.3.0/32 is subnetted, 1 subnets
```

```
O       192.168.3.3 [110/12] via 172.16.24.4, 00:11:38, Ethernet0

cisco-4#show running-config
Building configuration...

Current configuration : 1009 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname cisco-4
!
enable password labuser
!
ip subnet-zero
!
!
!
call rsvp-sync
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 192.168.4.4 255.255.255.255
!
interface FastEthernet0/0
 ip address 172.16.24.4 255.255.255.248
 duplex half
!
interface FastEthernet3/0
 ip address 172.16.42.4 255.255.255.248
 duplex full
!
interface FastEthernet4/0
 ip address 172.16.34.4 255.255.255.248
 duplex full
!
router ospf 1
 log-adjacency-changes
 network 172.16.24.0 0.0.0.7 area 0.0.0.0
 network 172.16.34.0 0.0.0.7 area 0.0.0.0
 network 172.16.42.0 0.0.0.7 area 0.0.0.0
 network 192.168.4.4 0.0.0.0 area 0.0.0.0
!
ip classless
no ip http server
!
!
!
!
gatekeeper
 shutdown
!
!
line con 0
line aux 0
line vty 0 4
 password labuser
 login
line vty 5 15
 login
!
end
```

```
cisco-4#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/16 is variably subnetted, 9 subnets, 2 masks
C       172.16.42.0/29 is directly connected, FastEthernet3/0
C       172.16.34.0/29 is directly connected, FastEthernet4/0
O       172.16.31.0/29 [110/2] via 172.16.34.3, 00:20:32, FastEthernet4/0
C       172.16.24.0/29 is directly connected, FastEthernet0/0
O       172.16.21.0/24 [110/22] via 172.16.34.3, 00:20:32, FastEthernet4/0
O       172.16.22.0/24 [110/21] via 172.16.42.2, 00:20:32, FastEthernet3/0
O       172.16.12.0/29 [110/21] via 172.16.42.2, 00:19:18, FastEthernet3/0
O       172.16.13.0/29 [110/11] via 172.16.34.3, 00:19:46, FastEthernet4/0
O       172.16.11.0/24 [110/21] via 172.16.34.3, 00:19:46, FastEthernet4/0
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.21.0/32 is subnetted, 1 subnets
O       192.168.21.1 [110/12] via 172.16.34.3, 00:20:33, FastEthernet4/0
     192.168.22.0/32 is subnetted, 1 subnets
O       192.168.22.2 [110/11] via 172.16.42.2, 00:20:33, FastEthernet3/0
     192.168.1.0/32 is subnetted, 1 subnets
O       192.168.1.1 [110/12] via 172.16.34.3, 00:19:47, FastEthernet4/0
     192.168.2.0/32 is subnetted, 1 subnets
O       192.168.2.2 [110/2] via 172.16.24.2, 00:19:19, FastEthernet0/0
     192.168.3.0/32 is subnetted, 1 subnets
O       192.168.3.3 [110/2] via 172.16.34.3, 00:20:33, FastEthernet4/0

RS-1# show running-config
Running system configuration:
     !
     ! Last modified from Console on 2003-03-10 15:10:27
     !
 1 : interface create ip gi.2.1 address-netmask 172.16.31.1/29 port gi.2.1
 2 : interface create ip et.1.2 address-netmask 172.16.12.1/29 port et.1.2
 3 : interface create ip LAN address-netmask 172.16.21.1/24 port et.1.3
 4 : interface add ip lo0 address-netmask 192.168.21.1/32
     !
 5 : ip-router global set router-id 192.168.21.1
     !
 6 : ospf create area backbone
 7 : ospf add interface all to-area backbone
 8 : ospf add stub-host 192.168.21.1 to-area backbone cost 10
 9 : ospf start
     !
10 : system set name RS-1

RS-1# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
172.16.11.0/24        172.16.31.3          OSPF      gi.2.1
172.16.12.0/29       directly connected   -         et.1.2
172.16.13.0/29       172.16.31.3          OSPF      gi.2.1
172.16.21.0/24       directly connected   -         LAN
172.16.22.0/24       172.16.31.3          OSPF      gi.2.1
172.16.24.0/29       172.16.31.3          OSPF      gi.2.1
172.16.31.0/29       directly connected   -         gi.2.1
172.16.34.0/29       172.16.31.3          OSPF      gi.2.1
172.16.42.0/29       172.16.31.3          OSPF      gi.2.1
192.168.1.1          172.16.31.3          OSPF      gi.2.1
192.168.2.2          172.16.31.3          OSPF      gi.2.1
192.168.3.3          172.16.31.3          OSPF      gi.2.1
```

```
192.168.4.4          172.16.31.3          OSPF      gi.2.1
192.168.21.1         192.168.21.1         -         lo0
192.168.22.2         172.16.31.3          OSPF      gi.2.1

RS-2# show running-config
Running system configuration:
     !
     ! Last modified from Console on 2003-03-10 15:06:38
     !
 1 : port set et.1.1 duplex full speed 100mbps
     !
 2 : interface create ip et.1.1 address-netmask 172.16.42.2/29 port et.1.1
 3 : interface create ip et.1.2 address-netmask 172.16.12.2/29 port et.1.2
 4 : interface create ip LAN address-netmask 172.16.22.2/24 port et.1.3
 5 : interface add ip lo0 address-netmask 192.168.22.2/32
     !
 6 : ip-router global set router-id 192.168.22.2
     !
 7 : ospf create area backbone
 8 : ospf add interface all to-area backbone
 9 : ospf add stub-host 192.168.22.2 to-area backbone cost 10
10 : ospf start
     !
11 : system set name RS-2

RS-2# ip show routes

Destination          Gateway              Owner     Netif
-----------          -------              -----     -----
127.0.0.1            127.0.0.1            -         lo0
172.16.11.0/24        172.16.42.4          OSPF      et.1.1
172.16.12.0/29       directly connected   -         et.1.2
172.16.13.0/29       172.16.42.4          OSPF      et.1.1
172.16.21.0/24       172.16.12.1          OSPF      et.1.2
172.16.22.0/24       directly connected   -         LAN
172.16.24.0/29       172.16.42.4          OSPF_IA   et.1.1
172.16.31.0/29       172.16.12.1          OSPF      et.1.2
                     172.16.42.4          OSPF      et.1.1
172.16.34.0/29       172.16.42.4          OSPF      et.1.1
172.16.42.0/29       directly connected   -         et.1.1
192.168.1.1          172.16.42.4          OSPF      et.1.1
192.168.2.2          172.16.42.4          OSPF      et.1.1
192.168.3.3          172.16.42.4          OSPF      et.1.1
192.168.4.4          172.16.42.4          OSPF      et.1.1
192.168.21.1         172.16.12.1          OSPF      et.1.2
192.168.22.2         192.168.22.2         -         lo0
```

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