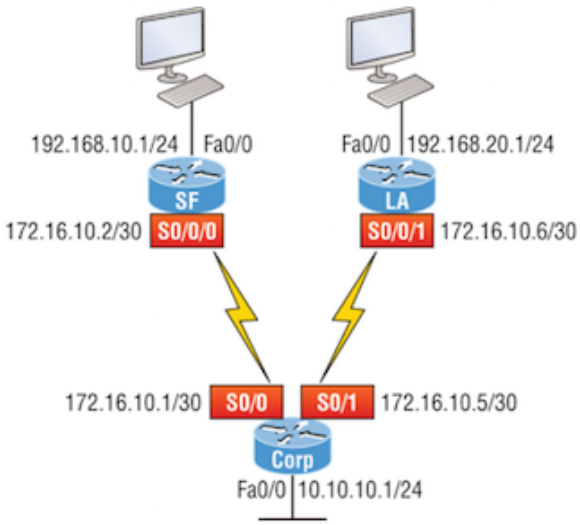
Basic IGP Routing in IPv4

The three types of routing are static (in which routes are manually configured at the CLI), dynamic (in which the routers share routing information via a routing protocol), and default routing (in which a special route is configured for all traffic without a more specific destination network found in the table)



Basic layout to setup
Central1 - in diagram is CORP
Serial 0/0: 172.16.10.1/30
Serial 0/1: 172.16.10.5/30
Fa0/0: 10.10.10.1/24

DFW - in diagram is SF
S0/0/0: 172.16.10.2/30
Fa0/0: 192.168.10.1/24

HOU - in diagram is LA
S0/0/0: 172.16.10.6/30
Fa0/0: 192.168.20.1/24

Basic Local IPv4 Routing (Direct Connections)

Every interface below should have "no shutdown" added. It has been removed here for brevity

```
Router(config)#hostname Central1
Central1(config)#int f0/0
Central1(config-if)#desc Connection to LAN
Central1(config-if)#ip address 10.10.10.1 255.255.255.0
Central1(config-if)#int s0/0
Central1(config-if)#desc WAN connection to DFW
Central1(config-if)#ip address 172.16.10.1 255.255.255.252
Central1(config-if)#int s0/1
Central1(config-if)#desc WAN connection to HOU
Central1(config-if)#ip address 172.16.10.5 255.255.255.252
Central1>sh controllers s0/0
    Interface Serial0/0
    Hardware is PowerQUICC MPC860
    DTE V.35 TX and RX clocks detected.
```

Remember to set clock rates on the DCEs!

```
Router(config)#hostname DFW
DFW(config)#int s0/0/0
DFW(config-if)#desc WAN Connection to Central1
DFW(config-if)#ip address 172.16.10.2 255.255.255.252
DFW(config-if)#clock rate 1000000   - DFW's DCE to Central's DTE -we need a clock rate!
DFW(config-if)#int f0/0
DFW(config-if)#desc DFW LAN
DFW(config-if)#ip address 192.168.10.1 255.255.255.0

Router(config)#hostname HOU
HOU(config)#int s0/0/1
HOU(config-if)#ip address 172.16.10.6 255.255.255.252
HOU(config-if)#clock rate 1000000        - HOU's DCE to Central1's DTE -we need a clock rate
HOU(config-if)#description WAN To Central1
HOU(config-if)#int f0/0
HOU(config-if)#ip address 192.168.20.1 255.255.255.0
HOU(config-if)#description HOU LAN
```

Static Routing: Manually Adding to Routing Table

Router(config)#ip route 172.16.3.0 255.255.255.0 192.168.2.4

172.16.3.0 is the remote network, and 255.255.255.0 is it's mask of the remote network.

192.168.2.4 is the next hop that packets will be sent to. Can also be the interface out to it.

Below, the 150 is where the administrative distance goes if you want to override the default. This is set here because in the next example, we will add routes with RIP, and using 150 (rather than the default of 1) means we won't have to remove static routes first- RIP (120) will just override them.

Administrative Distances (the smaller # wins out):

Connected	0	OSPF	110
Static route	1	RIP	120
EIGRP	90	Unknown	255

Central1(config)#ip route 192.168.10.0 255.255.255.0 172.16.10.2 150 --use the dest IP out
Central1(config)#ip route 192.168.20.0 255.255.255.0 s0/1 150 -- use an interface out

DFW(config)#ip route 10.10.10.0 255.255.255.0 172.16.10.1 150
DFW(config)#ip route 172.16.10.4 255.255.255.252 172.16.10.1 150
DFW(config)#ip route 192.168.20.0 255.255.255.0 172.16.10.1 150

HOU#config t
HOU(config)#ip route 10.10.10.0 255.255.255.0 172.16.10.5 150
HOU(config)#ip route 172.16.10.0 255.255.255.252 172.16.10.5 150
HOU(config)#ip route 192.168.10.0 255.255.255.0 172.16.10.5 150

A stub indicates that the networks in this design have only one way out to reach all other networks; use only a default route. Here's an alt config instead of typing in the static routes. to make this a "stubby network" (first we turn off the routes we just configured):
HOU(config)#no ip route 10.10.10.0 255.255.255.0 172.16.10.5 150
HOU(config)#no ip route 172.16.10.0 255.255.255.252 172.16.10.5 150
HOU(config)#no ip route 192.168.10.0 255.255.255.0 172.16.10.5 150
HOU(config)#ip route 0.0.0.0 0.0.0.0 172.16.10.5

Convert from Static IPv4 to Dynamic IPv4 RIPv2

As a shortcut, you can verify directly connected networks to know what to configure RIP with:
Central1#sh ip int brief

Interface	IP-Address	OK?	Method	Status	Protocol
FastEthernet0/0	10.10.10.1	YES	manual	up	up
Serial0/0	172.16.10.1	YES	manual	up	up
FastEthernet0/1	unassigned	YES	unset	admin. down	down
Serial0/1	172.16.10.5	YES	manual	up	up

When we declare our routes in RIP, we need to refer to them in a classful way instead of by the specific subnet. This is illustrated below. RIP then finds the subnets and fills in the routing table (RIP is NOT a classful routing protocol btw).

Central1(config)#router rip
Central1(config-router)#network 10.0.0.0
Central1(config-router)#network 172.16.0.0
Central1(config-router)#version 2
Central1(config-router)#no auto-summary
Add the default as a static route, and enter RIP config to set default-info originate to propagate it.
Central1(config)#ip route 0.0.0.0 0.0.0.0 Fa0/0
Central1(config)#router rip
Central1(config-router)#default-information originate

DFW(config)#router rip
DFW(config-router)#network 192.168.10.0
DFW(config-router)#network 172.16.0.0
DFW(config-router)#version 2
DFW(config-router)#no auto-summary *---disabling auto-summary makes RIP look at our subnets*

DFW(config-router)#do show ip route

```
C    192.168.10.0/24 is directly connected, FastEthernet0/0
L    192.168.10.1/32 is directly connected, FastEthernet0/0
     172.16.0.0/30 is subnetted, 3 subnets
R       172.16.10.4 [120/1] via 172.16.10.1, 00:00:08, Serial0/0/0
C       172.16.10.0 is directly connected, Serial0/0/0
L       172.16.10.2/32 is directly connected, Serial0/0
S    192.168.20.0/24 [150/0] via 172.16.10.1
     10.0.0.0/24 is subnetted, 1 subnets
R       10.10.10.0 [120/1] via 172.16.10.1, 00:00:08, Serial0/0/0
```

- Note above the administrative distances set for RIP (R) and our previous static routes (S)
HOU(config)#no ip route 0.0.0.0 0.0.0.0 *--- get rid of that temporary default route we set for HOU*
HOU(config)#router rip
HOU(config-router)#network 192.168.20.0
HOU(config-router)#network 172.16.0.0
HOU(config-router)#no auto
HOU(config-router)#vers 2

Switch from IPv4 RIP to Dynamic IPv4 OSPF
Central1(config)#no router rip
Central1(config)#router ospf 132
Central1(config-router)#network 10.10.10.1 0.0.0.255 area 0
Central1(config-router)#network 172.16.10.1 0.0.0.3 area 0
Central1(config-router)#network 172.16.10.5 0.0.0.3 area 0

DFW(config)#no router rip
DFW(config)#router ospf 300
DFW(config-router)#network 192.168.10.1 0.0.0.255 area 0
DFW(config-router)#network 172.16.10.0 0.0.0.7 area 0
[may need "area 1 range" for this, since it's a summary of two listed on Central1- see below]

HOU(config)#router ospf 100
HOU(config-router)#network 192.168.20.0 0.0.0.255 area 0
HOU(config-router)#network 172.16.10.0 0.0.0.7 area 0

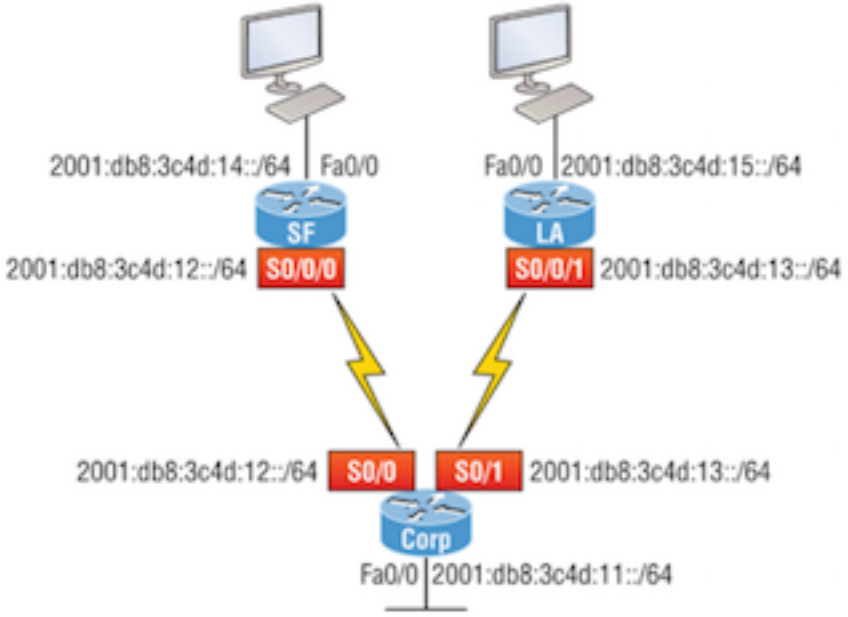
Adding a non-OSPF network? Use passive-interface:
HOU(config)#router ospf 100
HOU(config-router)#passive-interface fastEthernet 0/1

Add a SanAnt router:
Router(config)#hostname SanAnt
SanAnt(config)#int f0/0
SanAnt(config-if)#ip address 10.10.10.2 255.255.255.0
SanAnt(config-if)#no shut
SanAnt(config-if)#router ospf 2
SanAnt(config-router)#network 10.10.10.0 0.0.255.255 area 0

OSPF Route summarization:
Router(config)#router ospf 100
Interarea: area 1 range 192.168.5.8 0.0.0.63
External: summary-address: 192.168.64.0 0.0.224.0

RouterID - So what if you didn't put in a loopback first and need to force a router to become DR?
Corp(config-router)#router-id 223.255.255.254
Corp(config-router)#do clear ip ospf process
[Just set a routerID which will beat any other RID or loopback set on other routers, then reset OSPF]

Basic IGP Routing in IPv6



Adding IPv6 (including local default routing)

Add IPv6 to the Central1, DFW, and HOU routers by using a simple subnet scheme of 11, 12, 13, 14, and 15

```
Central1#config t
Central1(config)#ipv6 unicast-routing
Central1(config)#int f0/0
Central1(config-if)#ipv6 address 2001:db8:3c4d:11::/64 eui-64
Central1(config-if)#int s0/0
Central1(config-if)#ipv6 address 2001:db8:3c4d:12::/64 eui-64
Central1(config-if)#int s0/1
Central1(config-if)#ipv6 address 2001:db8:3c4d:13::/64 eui-64

DFW(config)#ipv6 unicast-routing
DFW(config)#int s0/0/0
DFW(config-if)#ipv6 address 2001:db8:3c4d:12::/64 eui-64
DFW(config-if)#int fa0/0
DFW(config-if)#ipv6 address 2001:db8:3c4d:14::/64 eui-64

HOU(config)#ipv6 unicast-routing
HOU(config)#int s0/0/1
HOU(config-if)#ipv6 address 2001:db8:3c4d:13::/64 eui-64
HOU(config-if)#int f0/0
HOU(config-if)#ipv6 address 2001:db8:3c4d:15::/64 eui-64
```

Static IPv6 Routing

First static route line uses the next-hop address, and the exit interface on the second entry

(On the DFW router, use show ipv6 int brief, and then copy the interface address used for the next hop)

```
Central1(config)#ipv6 route 2001:db8:3c4d:14::/64  2001:DB8:3C4D:12:21A:2FFF:FEE7:4398 150
Central1(config)#ipv6 route 2001:DB8:3C4D:15::/64 s0/1 150
Central1(config)#do sho ipv6 route static
        S   2001:DB8:3C4D:14::/64 [150/0]
            via 2001:DB8:3C4D:12:21A:2FFF:FEE7:4398
```

For DFW and HOU routers put a single entry in each router to get to remote subnet 11 (Central1):

```
DFW(config)#ipv6 route 2001:db8:3c4d:11::/64 s0/0/0 150
HOU(config)#ipv6 route ::/0 s0/0/1  -- a default route
```

IPv6 RIPng (a different pair of routers for this one)

```
Austin(config)#ipv6 unicast-routing
Austin(config)#interface fastethernet 0/0
Austin(config-if)#ipv6 enable
Austin(config-if)#ipv6 address 2001:db8:c18:2::/64 eui-64
Austin(config-if)#ipv6 rip RIPNG1 enable
Austin(config-if)#interface fastethernet 0/1
Austin(config-if)#ipv6 enable
Austin(config-if)#ipv6 address 2001:db8:c18:1::/64 eui-64
Austin(config-if)#ipv6 rip RIPNG1 enable
Austin(config-if)#no shutdown

Houston(config)#ipv6 unicast-routing
Houston(config)#interface fastethernet 0/0
Houston(config-if)#ipv6 enable
Houston(config-if)#ipv6 address 2001:db8:c18:2::/64 eui-64
Houston(config-if)#ipv6 rip RIPNG1 enable
Houston(config-if)#interface fastethernet 0/1
Houston(config-if)#ipv6 enable
Houston(config-if)#ipv6 address 2001:db8:c18:3::/64 eui-64
Houston(config-if)#ipv6 rip RIPNG1 enable
```

Switch to IPv6 OSPF Routing

```
Central1(config)#int f0/0
Central1(config-if)#ipv6 ospf 1 area 0
Central1(config-if)#int s0/0
Central1(config-if)#ipv6 ospf 1 area 0
Central1(config-if)#int s0/1
Central1(config-if)#ipv6 ospf 1 area 0

DFW(config)#int f0/0
DFW(config-if)#ipv6 ospf 1 area 0
DFW(config-if)#int s0/0/0
DFW(config-if)#ipv6 ospf 1 area 0
[Same for others]

SanAnt(config)#int f0/0
SanAnt(config-if)#ipv6 address autoconfig default
SanAnt(config-if)#ipv6 ospf 1 area 0
```

The same IPv4 OSPF RID is still there- change the RID under the OSPF process ID in the global config:

```
Central1(config)#ipv6 router ospf 1
Central1(config-rtr)#router-id 1.1.1.1
Central1(config-rtr)#do clear ip ospf process
```

Switching from IPv6 OSPF to IPv6 EIGRP

(you have to turn off OSPF on the interfaces, then add)

```
Central1(config)#int f0/0
Central1(config-if)#no ipv6 ospf 1 area 0
Central1(config-if)# ipv6 eigrp 1
Central1(config-if)#exit
        [Do for all interfaces]
DFW(config)#int f0/0
DFW(config-if)#no ipv6 ospf 1 area 0
DFW(config-if)# ipv6 eigrp 1
DFW(config-if)#exit
DFW(config-if)#int s0/0/0
 [Same for others]
```

Dynamic IGP Routing Protocols - Quick Overview

RIP for IPv4
Central1(config)#router rip
Central1(config-router)#network 10.0.0.0
Central1(config-router)#network 172.16.0.0
Central1(config-router)#version 2
Central1(config-router)#no auto-summary
Add the default as a static route, and enter RIP config to set default-info originate to propagate it.
Central1(config)#ip route 0.0.0.0 0.0.0.0 Fa0/0
Central1(config)#router rip
Central1(config-router)#default-information originate

RIPng for IPv6 - add to interfaces
Austin(config)#ipv6 unicast-routing
Austin(config)#interface fastethernet 0/0
Austin(config-if)#ipv6 enable
Austin(config-if)#ipv6 address 2001:db8:c18:2::/64 eui-64
Austin(config-if)#ipv6 rip RIPNG1 enable
Austin(config-if)#interface fastethernet 0/1
Austin(config-if)#ipv6 enable
Austin(config-if)#ipv6 address 2001:db8:c18:1::/64 eui-64
Austin(config-if)#ipv6 rip RIPNG1 enable
Austin(config-if)#no shutdown

OSPF for IPv4
int loopback 0
ip address 172.31.1.1 255.255.255.255
router ospf 300
Test(config-router)#network 192.168.10.64 0.0.0.15 area 0
Test(config-router)#network 192.168.10.80 0.0.0.15 area 0

OSPFv3 for IPv6 - add to interfaces
Corp(config)#ipv6 router ospf 1
Corp(config)#ipv6 router-id 1.1.1.1
Corp(config)#int f0/0
Corp(config-if)#ipv6 ospf 1 area 0

EIGRP for IPv4
Corp#config t
Corp(config)#router eigrp 20
Corp(config-router)#network 10.10.11.0 0.0.0.255
Corp(config-router)#network 172.16.10.0 0.0.0.3
Corp(config-router)#network 172.16.10.4 0.0.0.3
Corp(config-router)#no auto-summary

SF(config)#router eigrp 20
SF(config-router)#network 172.16.0.0
SF(config-router)#network 10.0.0.0
SF(config-router)#no auto-summary

EIGRPv6 for IPv6 - add to interfaces
Corp(config)#ipv6 unicast-routing
Corp(config)#ipv6 router eigrp 10
Corp(config-rtr)#no shut
Corp(config-rtr)#router-id 1.1.1.1
Corp(config-rtr)#int s0/0/0
Corp(config-if)#ipv6 eigrp 10
Corp(config-if)#int s0/0/1
Corp(config-if)#ipv6 eigrp 10