Network Administration
Class 3 - Routing

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Agenda

- Static Routing
- RIP
- OSPF

Routing

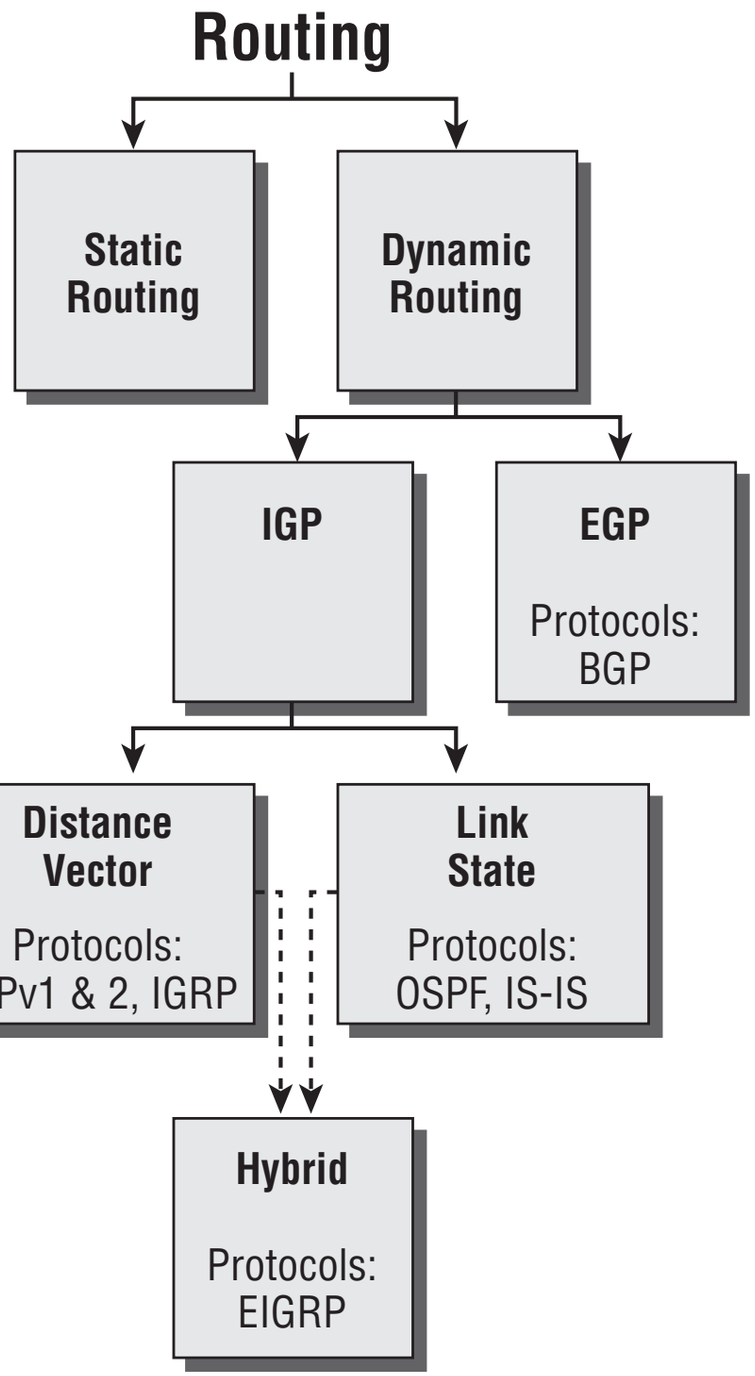
- Routers, route packets between networks
- Routers work at layer 3 of the OSI model
- If a router has a packet to route but the destination network is not in its routing table, then the packet will be dropped
- The information routers need are:
  - Destination address
  - Possible routes to all remote networks
  - The best route or path to a destination network
  - Neighbor routers from which it can learn routes and send data
  - A way to learn, update, and maintain route information

Administrative Distance

Protocol	Administrative Distance
Directly Connected	0
Static Route	1
EIGRP Summary	5
External BGP	20
Internal EIGRP	90
OSPF	110
IS-IS	115
RIP v1, v2	120
External EIGRP	170
Internal BGP	200
Unknown	255

Dynamic Routing

Unlike a static route, with dynamic routing you don't have to go to every single router and configure it for every destination network



An EGP works outside or between systems

An IGP operates and routes within an AS

Static Routes

Static Route Overview

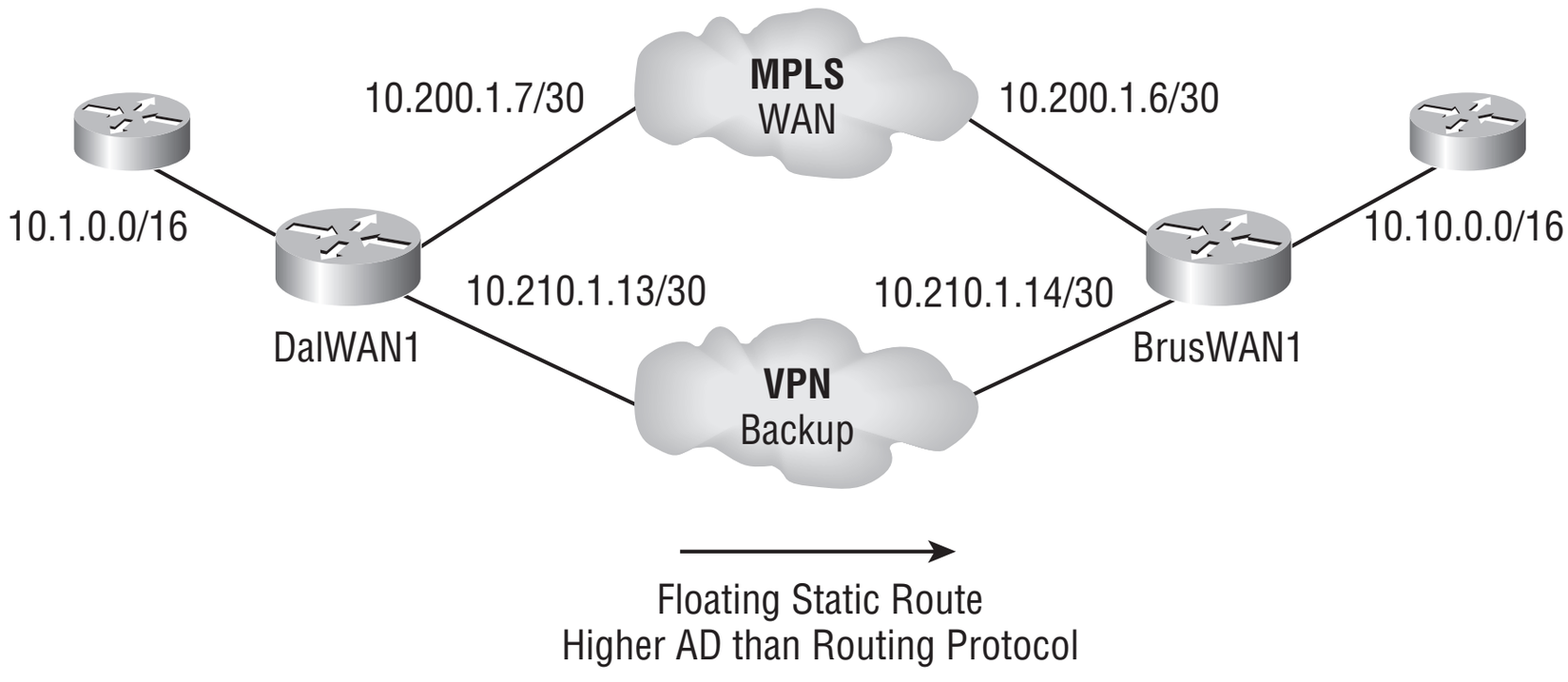
- You can use static routing to fix a small problem or hole in the network that is left by a dynamic routing protocol solution
- You can also use static routes to help chose a backup path when a primary fails (floating static route)
- Static routing can also be used to configure a default route
- The command to put a static route in the routing table is
  - ip route prefix mask { ip-address | interface-type interface-number } [distance]
- For example:
  - ip route 10.10.70.0 255.255.255.0 10.10.40.2 (Preferable)
  - ip route 10.10.70.0 255.255.255.0 Fa 0/3 (use on point to point links)

Default Route

- Route for all data not defined in the routing table
  - ip route 0.0.0.0 0.0.0.0 100.100.100.2
  - ip route 0.0.0.0 0.0.0.0 Fa0/0

Backup Route

- A static route configured with an administrative distance higher than the one in use, can be used to create a backup route to a destination
- For example:
  - ip route 10.10.0.0 255.255.0.0 10.210.1.14 95



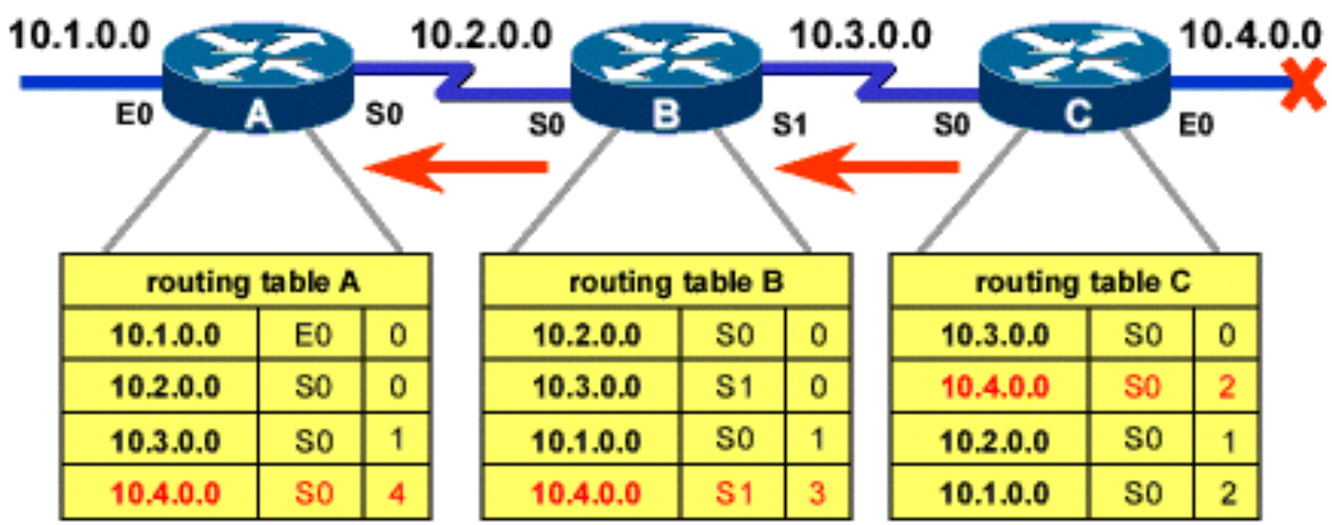
RIP

RIP

- For small networks
- Complete routing table out to all active interfaces at a set interval, by default every 30 seconds
- The maximum allowable hop count is 15
- Version 1, is classful
- Version 2, provides classless prefix routing

Preventing Loops

- Distance vector protocols use the following to prevent routing loops:
    - Maximum Hop Count - A route is considered unreachable after its exceeded
    - Split Horizon - Prevents sending routing information back in the direction from which it was learned
    - Route Poisoning - Sets a route to maximum hop count
    - Hold-downs - Timer that prevents advertising unreliable routes



RIP Configuration

- Basic configuration

```
# config t
(config)# router rip
(config-router)# version 2
(config-router)# network 192.168.1.0
```

- Summarization

```
(config-router)# no auto-summary
(config-router)# exit
(config)# interface fa 0/0
(config-if)# ip summary-address rip 10.0.0.0 255.255.0.0
```

RIP Verification

show ip protocols
show ip route
debug ip rip

Passive Interface

passive-interface fastEthernet 0/0

OSPF

OSPF Overview

- Open shortest path first (OSPF) is extremely versatile
- It is one of the most widely used open standard IP routing protocols today
- OSPF requires a hierarchical structure
- Routers use triggered updates to exchange information (Link State Advertisements)
- Responds quickly to changes in the network
- Dijkstra's algorithm, also known as Shortest Path First (SPF)

Overview

- Supports VLSM
- Has no hop count limit
- Uses a metric based on cost
- Equal cost load balancing

OSPF Terms

- Link - considered an interface (OSPF configured at the interface level)
- State - defined by the physical condition of the interface
- Neighbor and Adjacent router - a router that is connected to the same physical medium as the local router (Hello messages are exchanged between these routers)

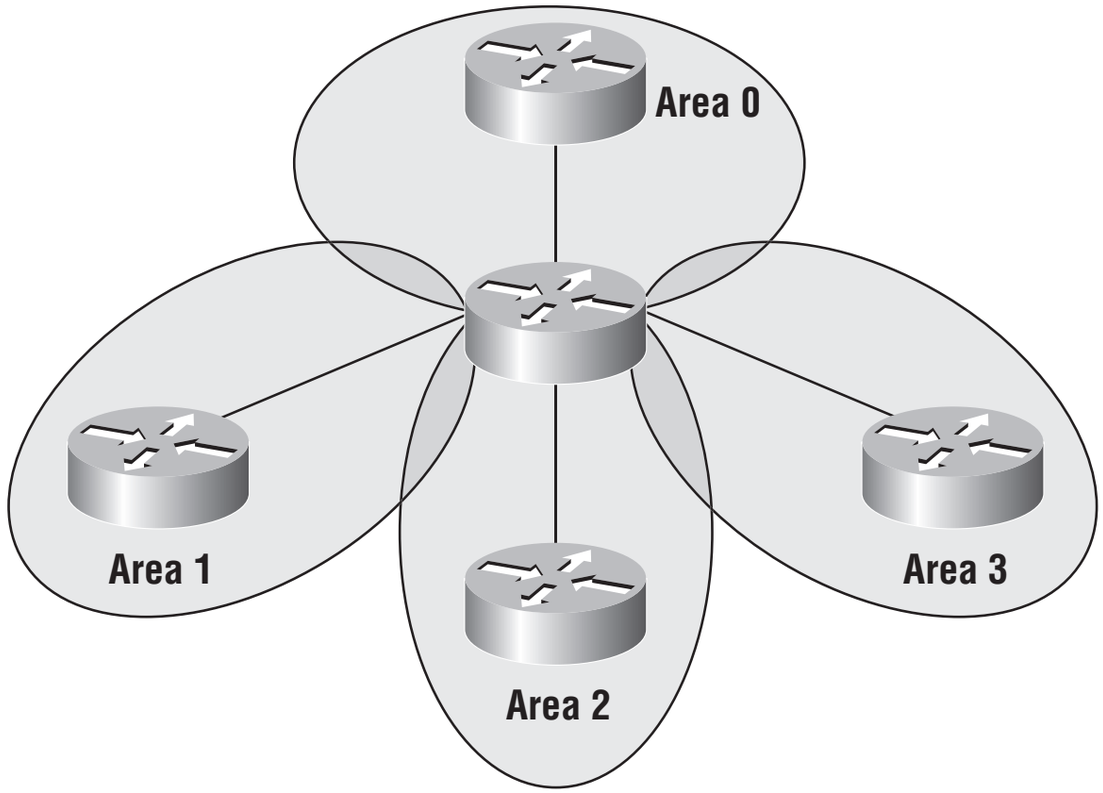
OSPF Areas

- Area - a collection of OSPF routers that share the same link state database

- Backbone area - Every OSPF network must have a backbone area, and all other areas are connected to it (area 0)

- Standard Area - subnets with hosts and end stations on them (subnets located in a switch block or branch office)

- Stub Area - area with one path to the rest of the network



OSPF Routers

- Backbone Router - has at least one interface located in the backbone area
- Area Border Router (ABR) - connects multiple areas
- Autonomous System Boundary Router (ASBR) - connects the local OSPF routing domain to another routing domain or protocol
- Internal Router - has all of its interfaces in the same area

OSPF Tables

- Neighbor Table - a list of all the directly connected routers to the local router

- Link State Database (LSDB) - stores all the network information for the internetwork or area in which the router is located

- Routing Table - Holds all of the best routes to each destination network

OSPF Cost

- OSPF only generates and sends routing updates when there is a change in the network topology
- When a link changes state, the device that detected the change creates a link state advertisement (LSA) for that link
- The LSA propagates to all neighboring devices usually using the multicast address 224.0.0.5
- OSPF calculates the OSPF metric for an interface according to the inverse bandwidth of the interface
- Cisco routers the cost is calculated using the formula (100 Mbps) / (bandwidth in Mbps
  - 64-kbps link = 100,000,000/64,000 = 1,562 for a metric
  - T1 link = 100,000,000/1,544,000 = 64 for a metric

Configuring OSPF

(config)# router ospf 1
(config)#router-id 1.1.1.1
(config-router)# network 10.0.0.1 0.0.0.3 area 0
(config-router)# network 10.0.0.5 0.0.0.3 area 1

Configure stub
(config-router)# area 1 stub

Verifying OSPF

```
# sh ip ospf neighbor
# sh ip ospf database
# sh ip route
# sh ip ospf interface
```

Lab Assignment 1

1. Using GNS, create a network with 3 routers

2. router 1 should connect to router 2 with a serial connection, and router 2 should also connect to router 3 with a serial connection

3. Configure fa 0/0 on router 1 and 3

4. Configure static routes so that router 1 can ping fa 0/0 on router 3, and vice versa

5. Remove static routes and configure with RIP

Lab Assignment 2

1. Configure 4 routers with OSPF
2. On two routers configure 4 loopbacks
3. Configure at least 2 OSPF Areas

Homework

- Read Chapters 4 and 5
- Preview Chapters 6 and 7