

Routing and Routing Protocols

Route Types

Static

Uses a programmed route that a network administrator enters into the router

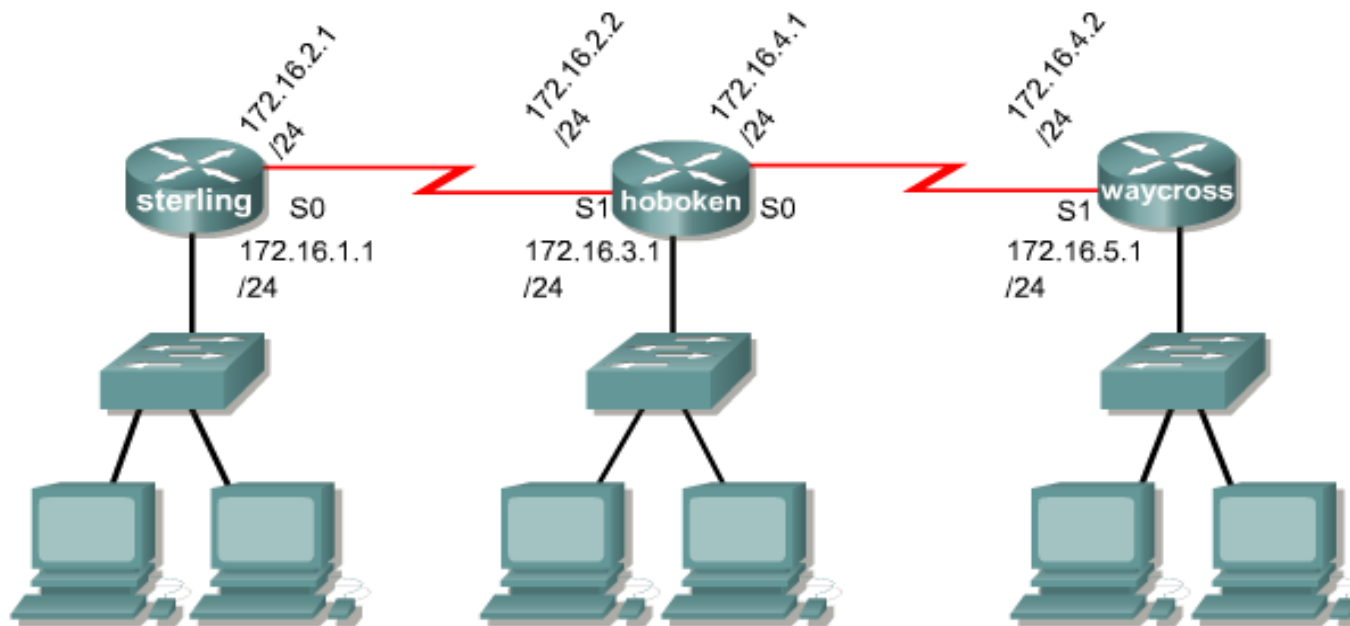
Dynamic

Uses a route that a routing protocol adjusts automatically for topology or traffic changes

Zinin's 3 routing principles

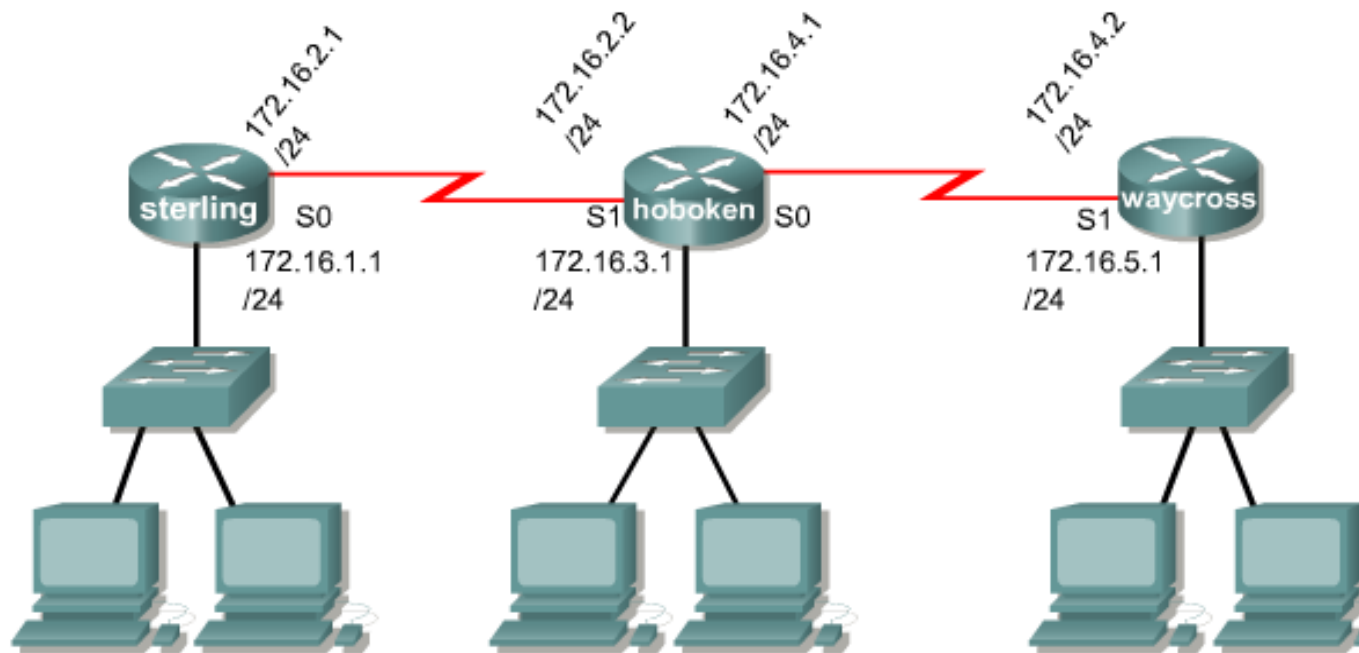
- **Principle 1: "Every router makes its decision alone, based on the information it has in its own routing table."**
 - **Principle 2: "The fact that one router has certain information in its routing table does not mean that other routers have the same information."**
 - **Principle 3: "Routing information about a path from one network to another does not provide routing information about the reverse, or return path."**

Specifying Outgoing Interface



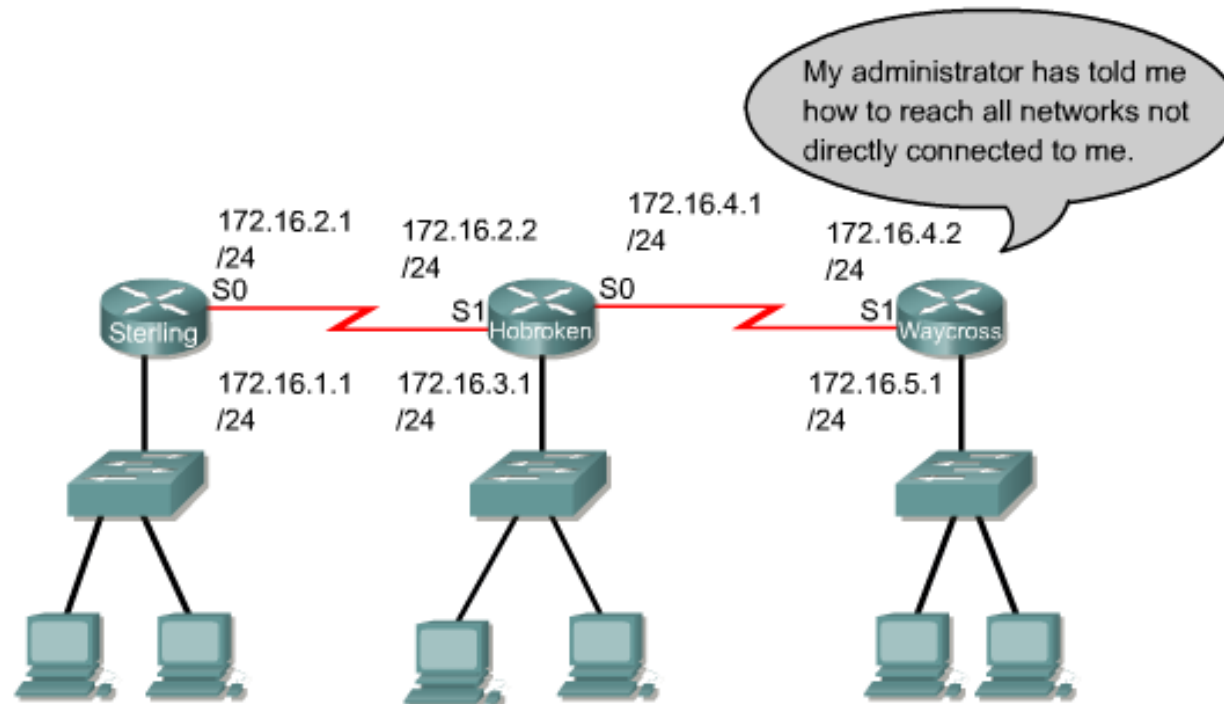
```
Hoboken(config)#ip route 172.16.1.0 255.255.255.0 s1
                    command destination sub mask gateway
                    network
Hoboken(config)#ip route 172.16.5.0 255.255.255.0 s0
                    command destination sub mask gateway
                    network
```

Specifying the Next-hop IP Address



```
Hoboken(config)#ip route 172.16.1.0 255.255.255.0 172.16.2.1
                    command destination sub mask gateway
                    network
Hoboken(config)#ip route 172.16.5.0 255.255.255.0 172.16.4.2
                    command destination sub mask gateway
                    network
```

Non-directly Connected Networks



```
Waycross(config)#ip route 0.0.0.0 0.0.0.0 S1
```

This command points to all non-directly-connected networks

Verifying Static Route Configuration

- The command `show running-config` is used to view the active configuration in RAM to verify that the static route was entered correctly.
- The `show ip route` command is used to make sure that the static route is present in the routing table

The show ip route Command Output

```
Router#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
```


Troubleshooting Static Route Configuration

- The `show interfaces` command
- The `ping` command
- The `traceroute` command

The ping and traceroute Commands

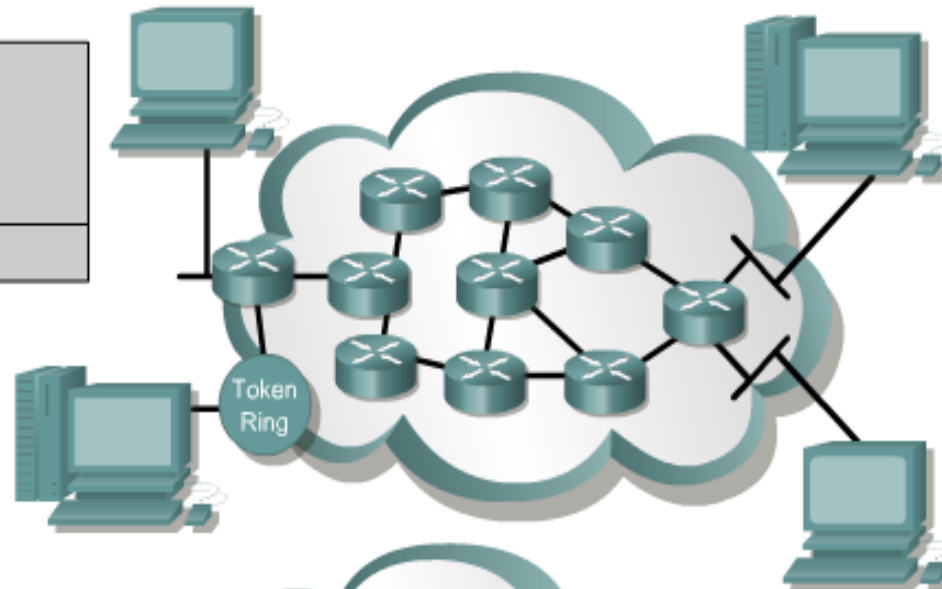
```
Sterling#ping 172.16.5.1
Type escape sequence to abort.
Sending 5,100-byte ICMP Echos to 172.16.5.1,timeout is 2
seconds:
.....
Success rate is 0 percent (0/5)

Sterling#traceroute 172.16.5.1
Type escape sequence to abort.
Tracing the route to 172.16.5.1
 0 172.16.2.2 16 msec 16 msec 16 msec
 1 172.16.4.2 32 msec 28 msec *
 2 * * *
 3 * * *
 4 * * *
 5 * * *
 6 * * *
```

Routed Versus Routing Protocol

Routed protocol
used between
routers to direct
user traffic

Examples: IP and IPX

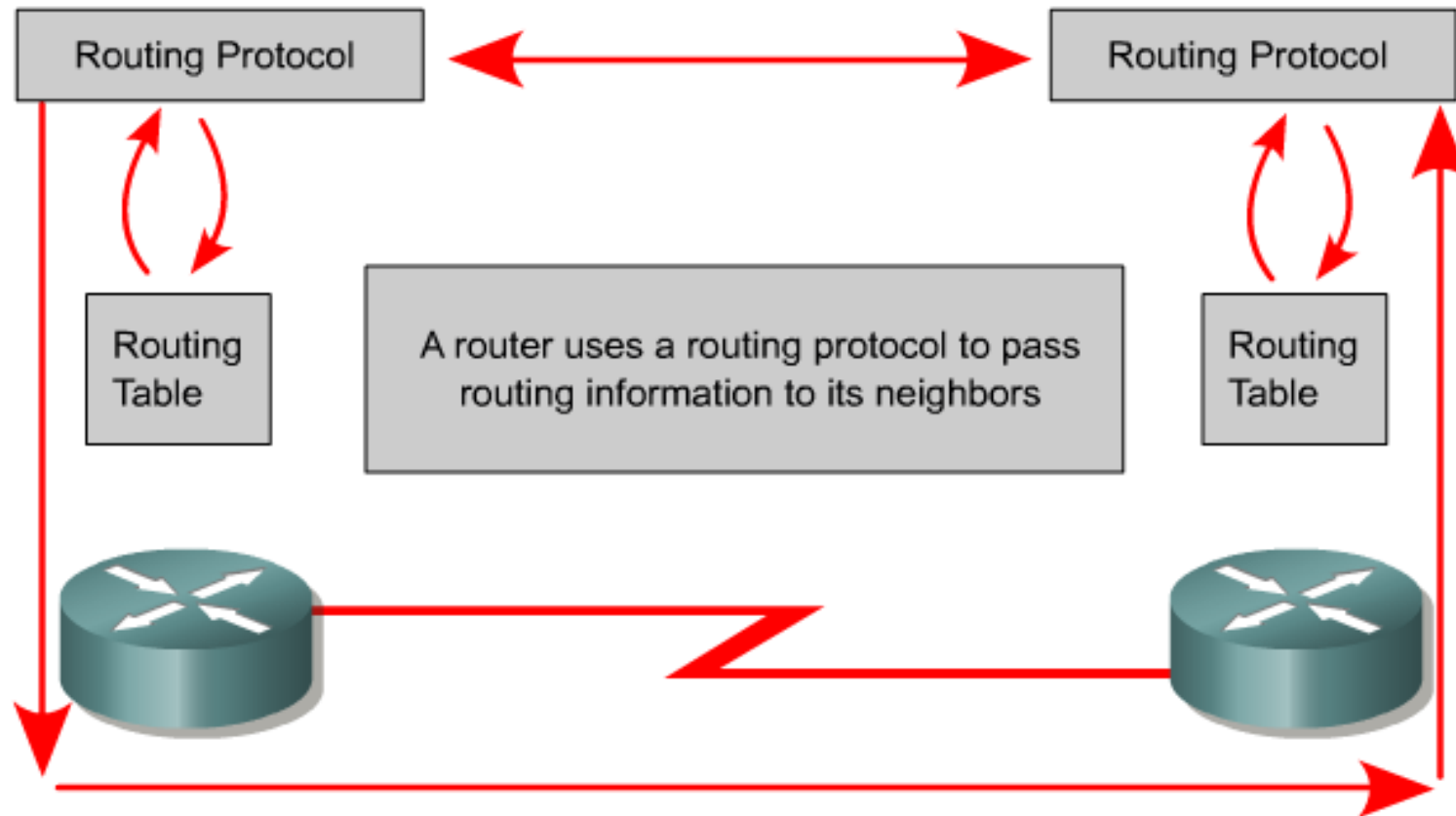


Routing protocol
used between
routers to maintain
tables

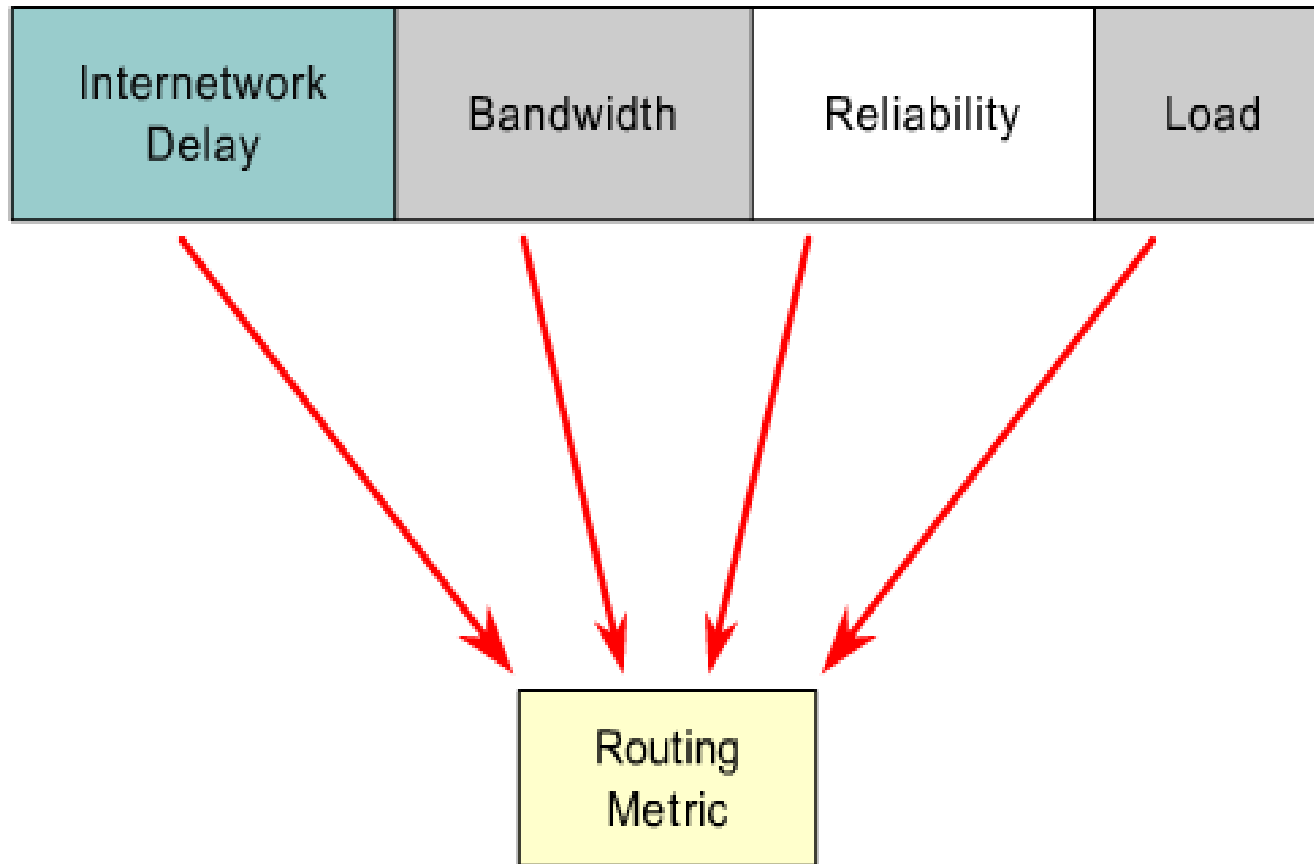
Examples: RIP, IGRP, OSPF



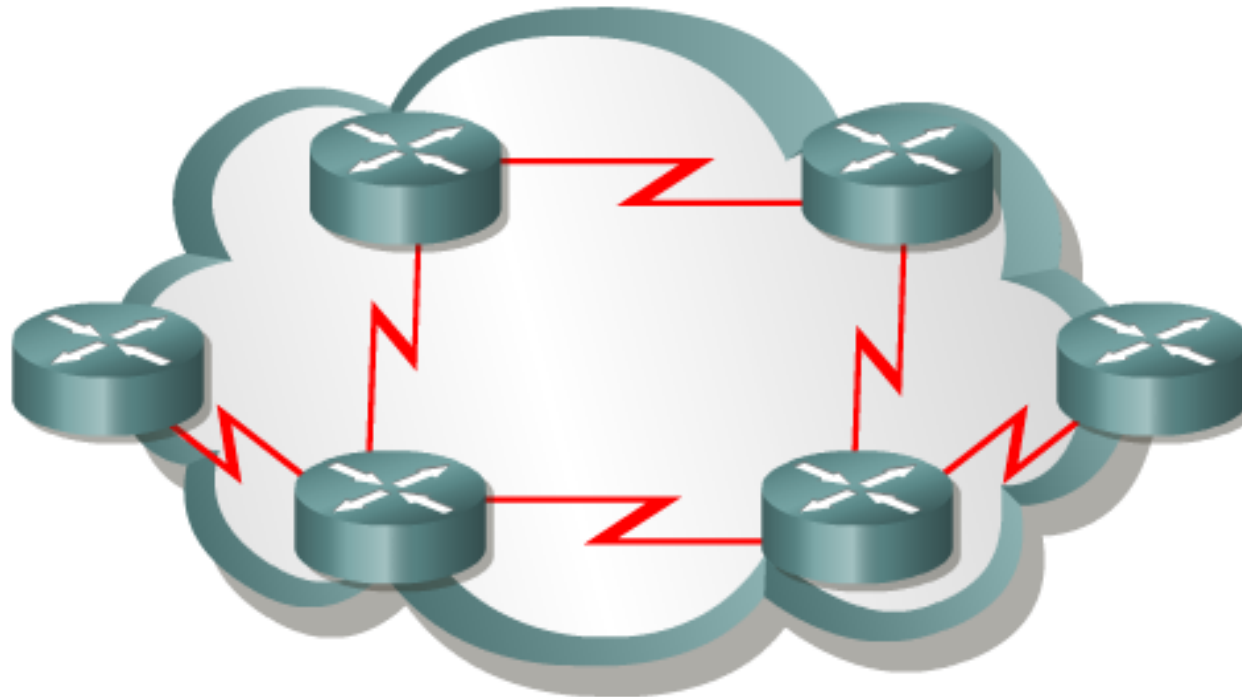
Dynamic Routing Operations



Routing Metric Components

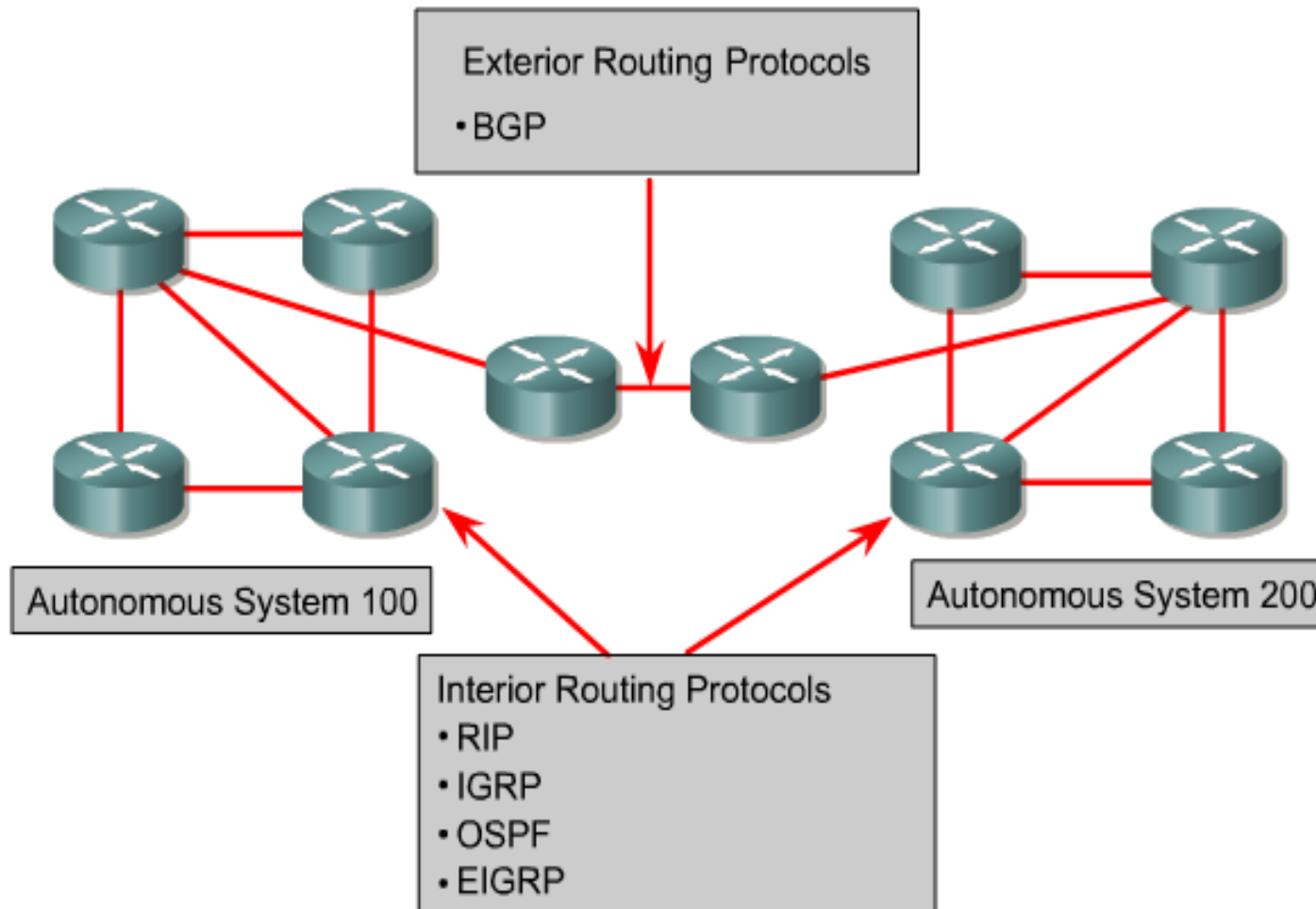


Autonomous Systems

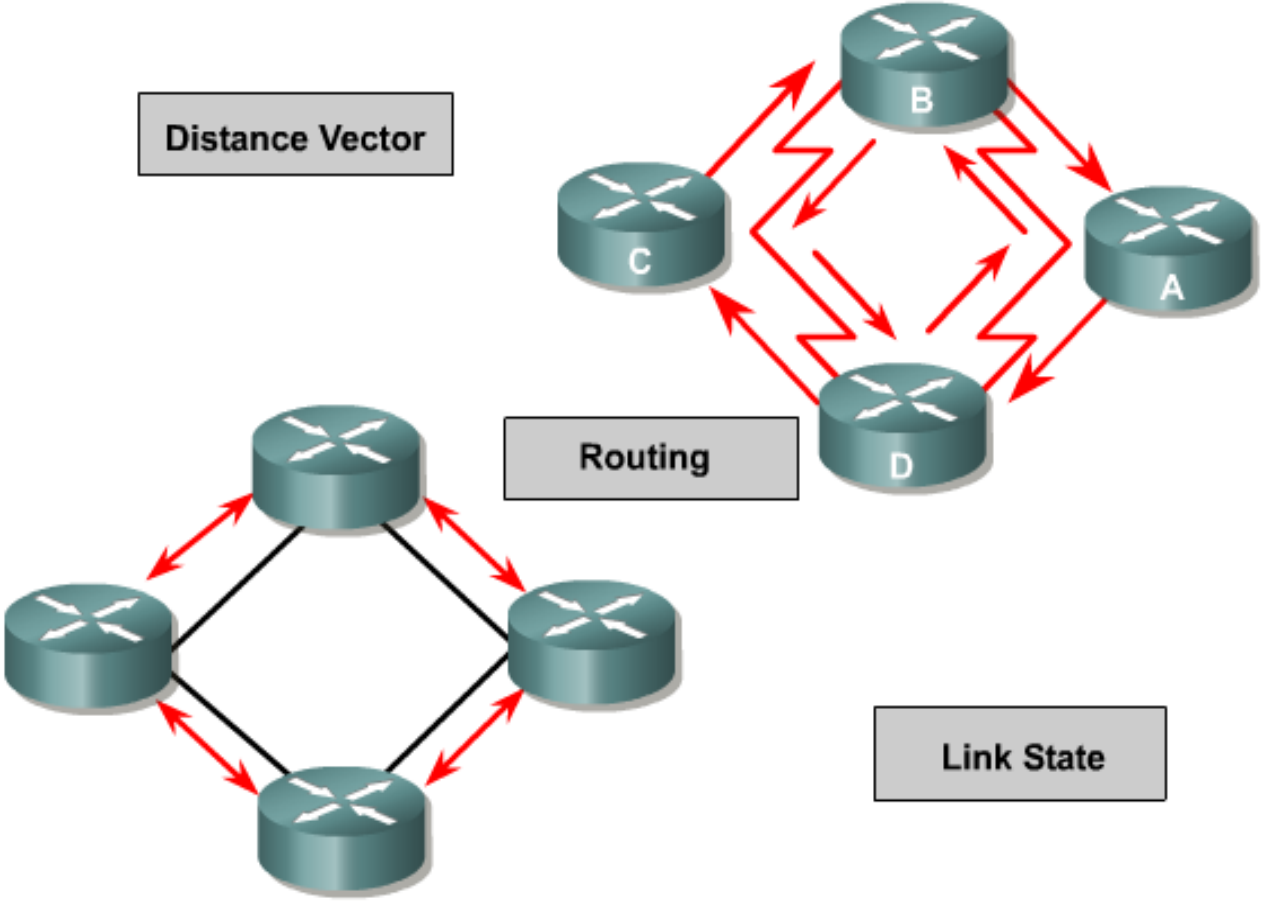


Routers under a common administration

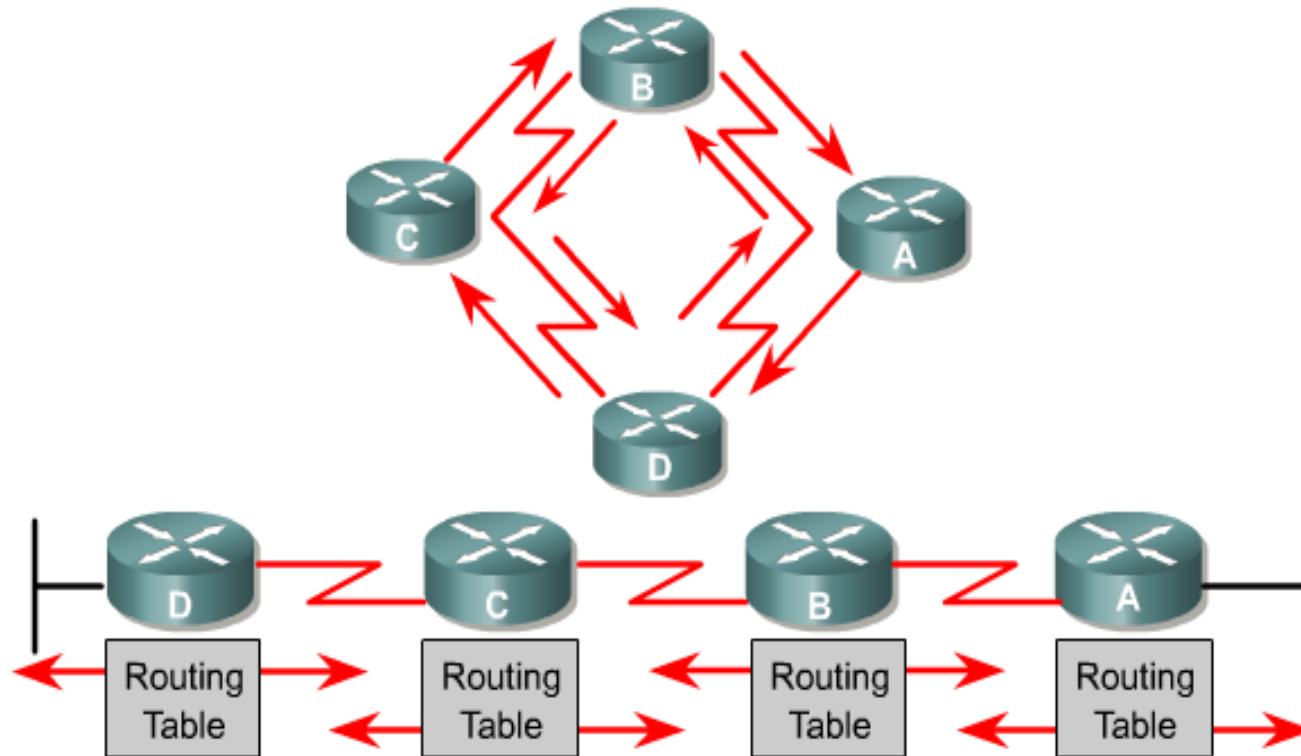
Routing Protocols



Classes of Routing Protocols

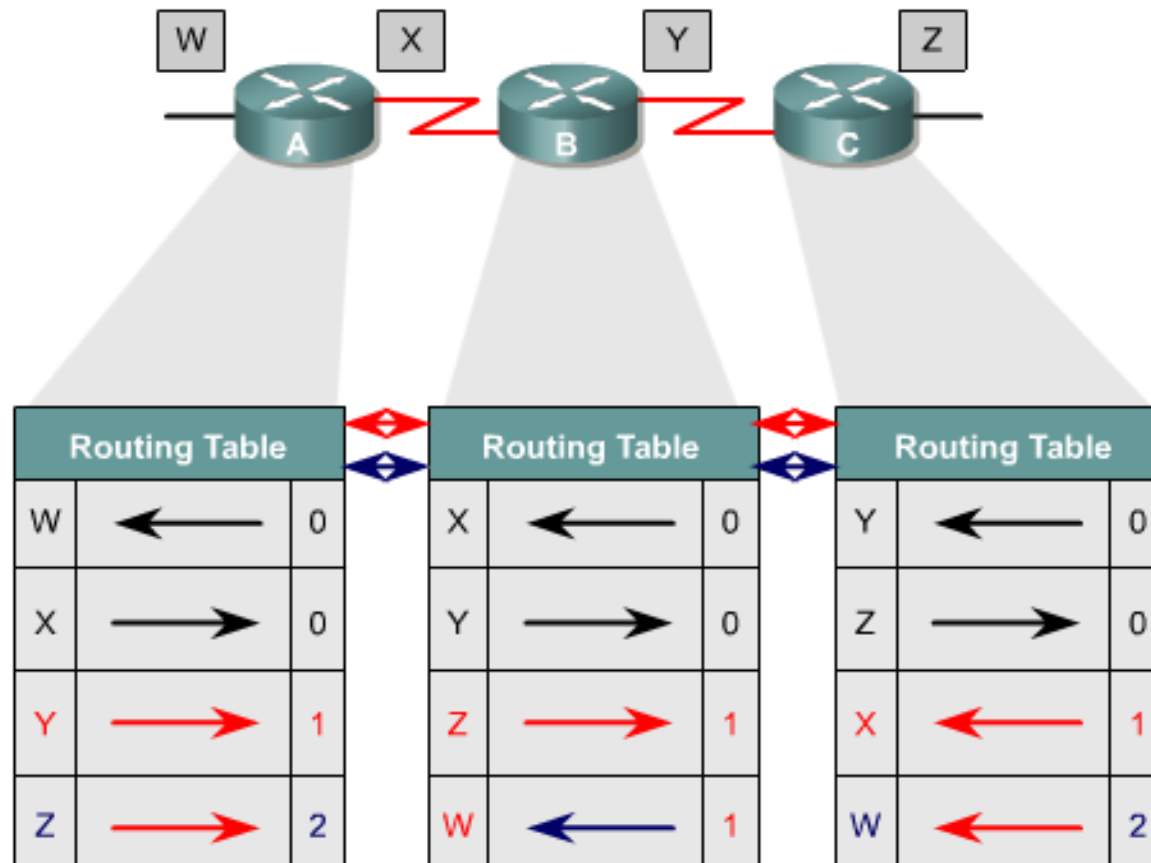


Distance Vector Concepts

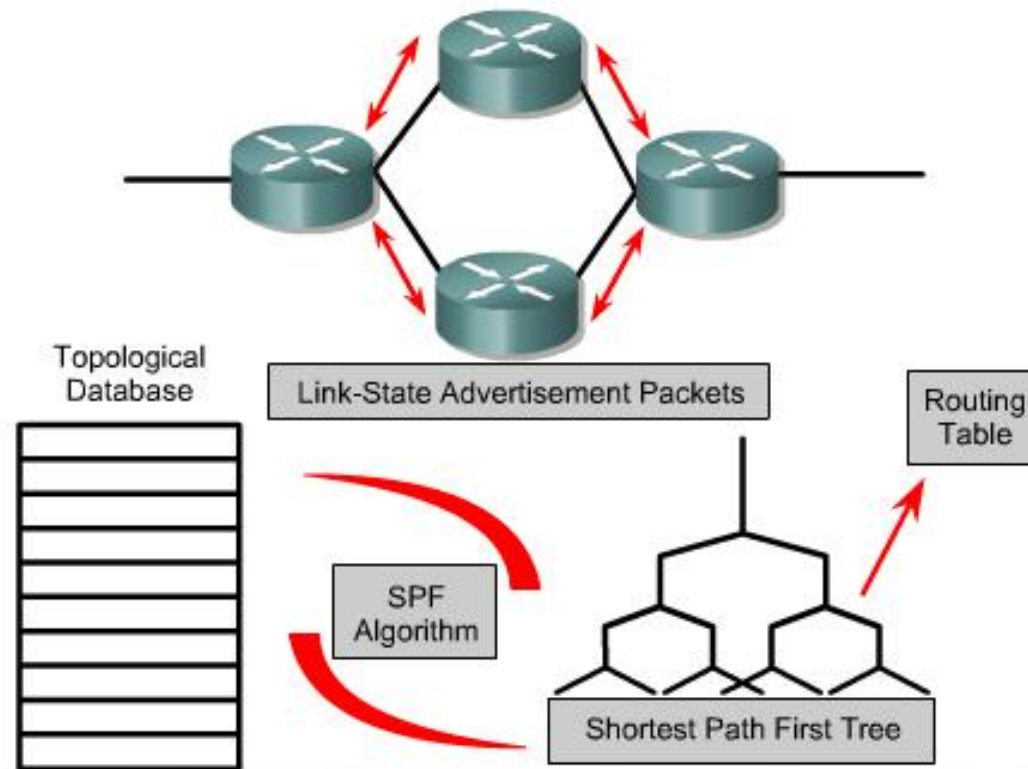


Pass periodic copies of a routing table to neighbor routers and accumulate distance vectors.

Distance Vector Network Discovery

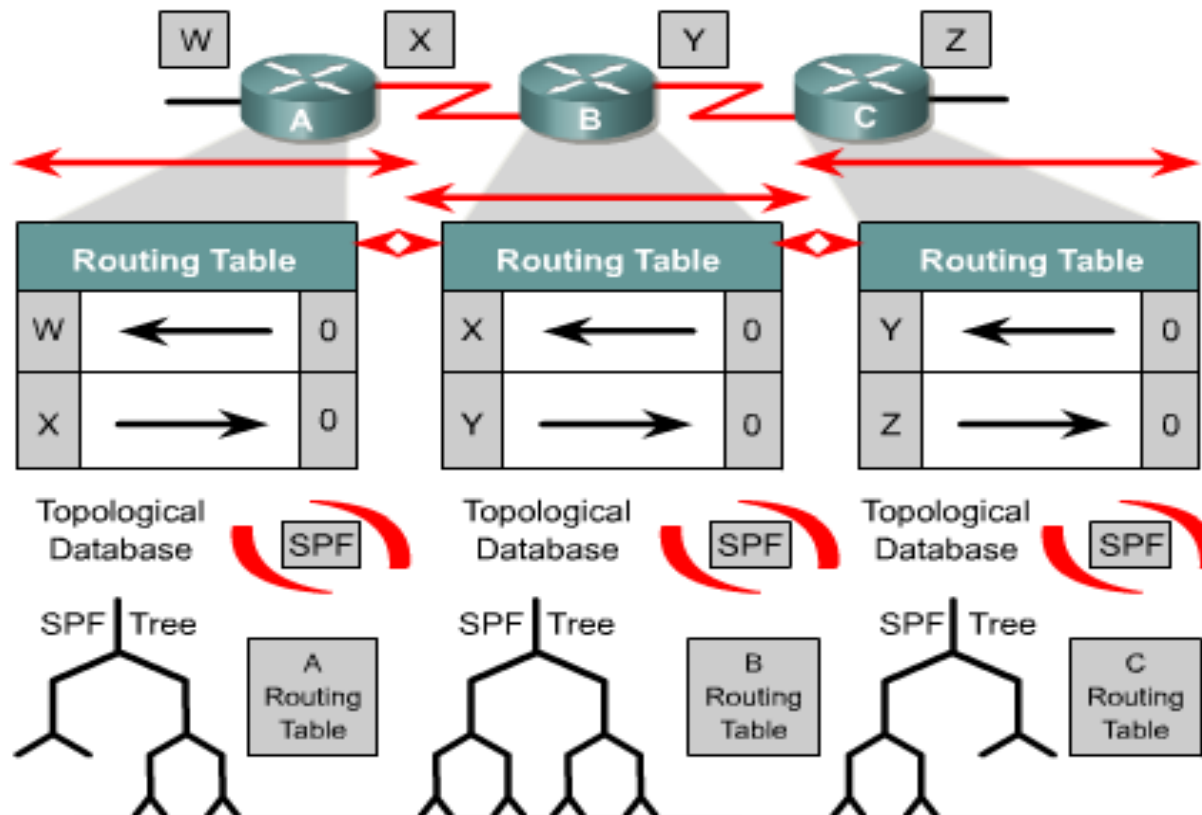


Link-State Concepts



Routers send LSAs to their neighbors. The LSAs are used to build a topological database. The SPF algorithm is used to calculate the shortest path first tree in which the root is the individual router. A routing table is then created.

Link-State Network Discovery



Each router has its own topological database on which the SPF algorithm is run.

Using the router and network Commands

Command

```
Router(config)#router protocol {options}
```

Defines an IP routing protocol

Command

```
Router(config-router)#network network-number
```

The network subcommand is a mandatory configuration command for each IP routing process