CCNA 200-301

Lesson 21

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OSPF Message types

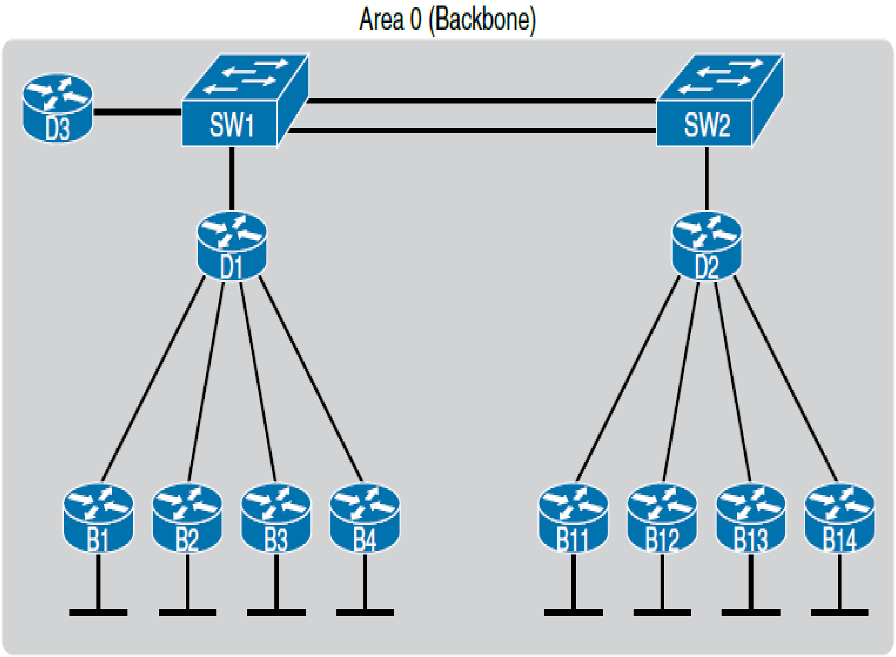
Type	Packet Name	Functional Overview
1	Hello	Packets are sent out periodically on all OSPF interfaces to discover new neighbors while ensuring that other neighbors are still online.
2	Database description (DBD or DDP)	Packets are exchanged when an OSPF adjacency is first being formed. These packets are used to describe the contents of the LSDB.
3	Link-state request (LSR)	When a router thinks that part of its LSDB is stale, it may request a portion of a neighbor's database using this packet type.
4	Link-state update (LSU)	This is an explicit LSA for a specific network link, and normally it is sent in direct response to an LSR.
5	Link-state acknowledgment	These packets are sent in response to the flooding of LSAs, thus making the flooding a reliable transport feature.

OSPF Areas and LSA

OSPF can be used in some networks with very little thought about design issues. You just turn on OSPF in all the routers, put all interfaces into the same area (usually area 0), and it works! Figure shows one such network example, with 11 routers and all interfaces in area 0.

Larger OSPFv2 networks suffer with a single-area design. For instance, now imagine an enterprise network with 900 routers, rather than only 11, and several thousand subnets. As it turns out, the CPU time to run the SPF algorithm on all that topology data just takes time. As a result, OSPFv2 convergence time—the time required to react to changes in the network— can be slow. The routers might run low on RAM as well. Additional problems with a single area design include the following:

- A larger topology database requires more memory on each router.
- The SPF algorithm requires processing power that grows exponentially compared to the size of the topology database.
- A single interface status change anywhere in the internetwork (up to down, or down to up) forces *every router* to run SPF again!



OSPF Areas

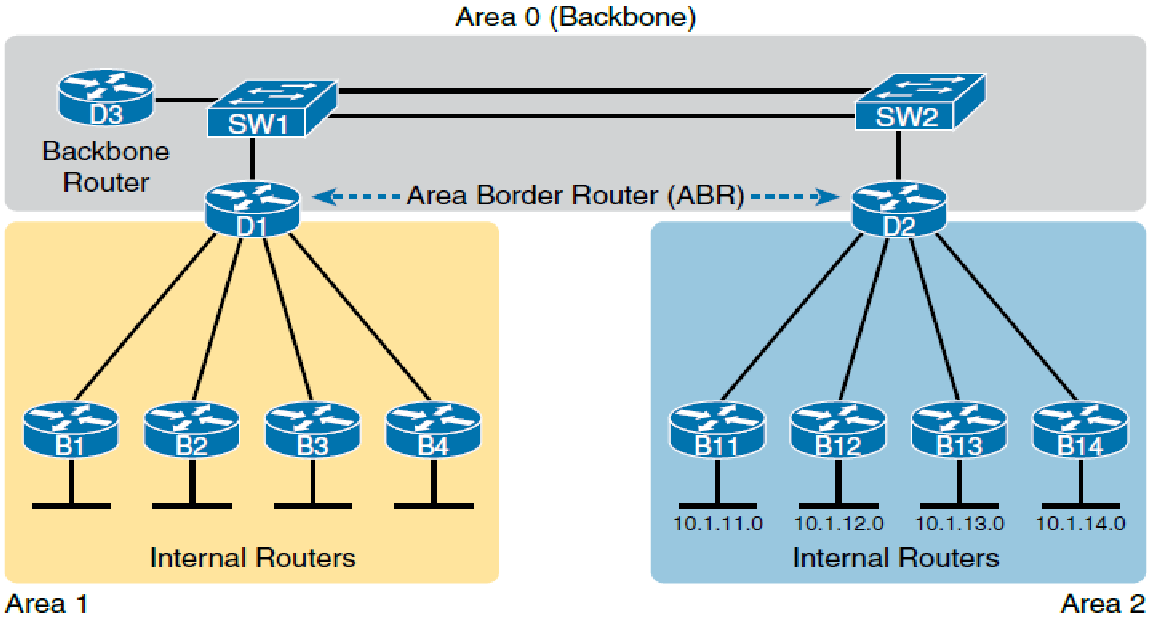
The solution is to take the one large LSDB and break it into several smaller LSDBs by using OSPF areas. With areas, each link is placed into one area. SPF does its complicated math on the topology inside the area, and that area's topology only.

So, how large does a network have to be before OSPF needs to use areas? Well, there is no set answer because the behavior of the SPF process depends largely on CPU processing speed, the amount of RAM, the size of the LSDB, and so on. Generally, networks larger than a few dozen routers benefit from areas, and some documents over the years have listed 50 routers as the dividing line at which a network really should use multiple OSPF areas.

OSPF area design follows a couple of basic rules. To apply the rules, start with a clean drawing of the internetwork, with routers, and all interfaces. Then choose the area for each router interface, as follows:

- Put all interfaces connected to the same subnet inside the same area.
- An area should be contiguous.
- Some routers may be internal to an area, with all interfaces assigned to that single area.
- Some routers may be Area Border Routers (ABR) because some interfaces connect to the backbone area, and some connect to nonbackbone areas.
- All nonbackbone areas must have a path to reach the backbone area (area 0) by having at least one ABR connected to both the backbone area and the nonbackbone area.

OSPF Areas cont.



Term	Description
Area Border Router (ABR)	An OSPF router with interfaces connected to the backbone area and to at least one other area
Backbone router	A router connected to the backbone area (includes ABRs)
Internal router	A router in one area (not the backbone area)
Area	A set of routers and links that shares the same detailed LSDB information, but not with routers in other areas, for better efficiency
Backbone area	A special OSPF area to which all other areas must connect—area 0
Intra-area route	A route to a subnet inside the same area as the router
Interarea route	A route to a subnet in an area of which the router is not a part

Link-State Advertisements

- **LSA Type** 1: Router **LSA**.
- **LSA Type** 2: Network **LSA**.
- **LSA Type** 3: Summary **LSA**.
- **LSA Type** 4: Summary ASBR **LSA**.
- **LSA Type** 5: Autonomous system external **LSA**.
- **LSA Type** 6: Multicast **OSPF LSA**.
- **LSA Type** 7: Not-so-stubby area **LSA**.
- **LSA Type** 8: External attribute **LSA** for BGP.

OSPF Configuration steps

The following list outlines the configuration steps covered in this first major section of the chapter:

Step 1. Use the **router ospf** *process-id* global command to enter OSPF configuration mode for a particular OSPF process.

Step 2. (Optional) Configure the OSPF router ID by doing the following:

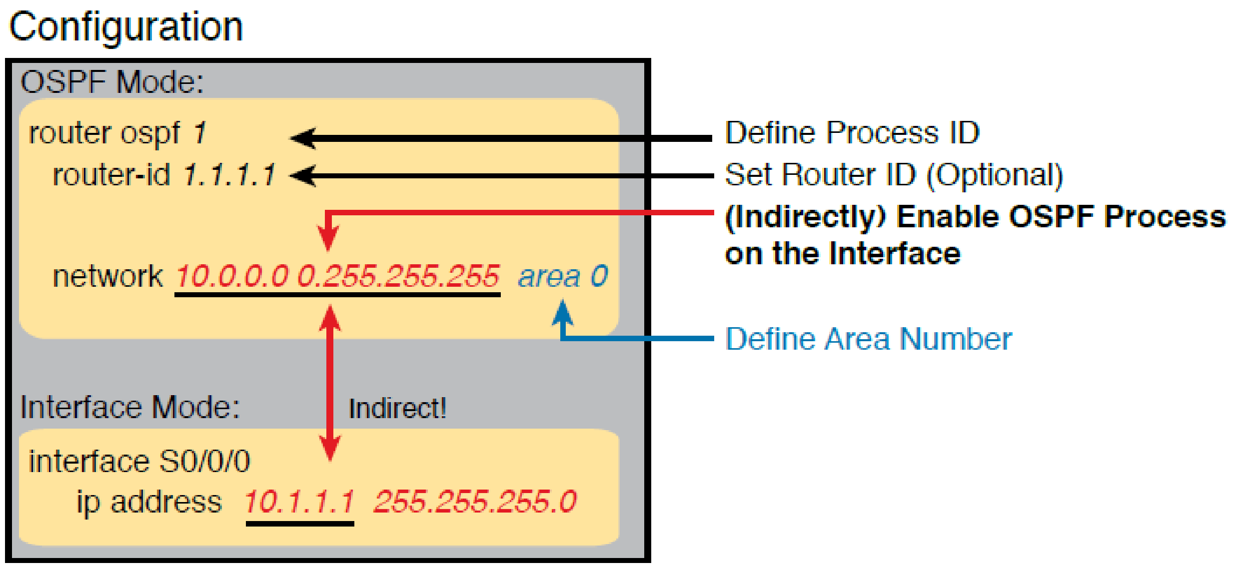
A. Use the **router-id** *id-value* router subcommand to define the router ID, or

B. Use the **interface loopback** *number* global command, along with an **ip address** *address mask* command, to configure an IP address on a loopback interface (chooses the highest IP address of all working loopbacks), or

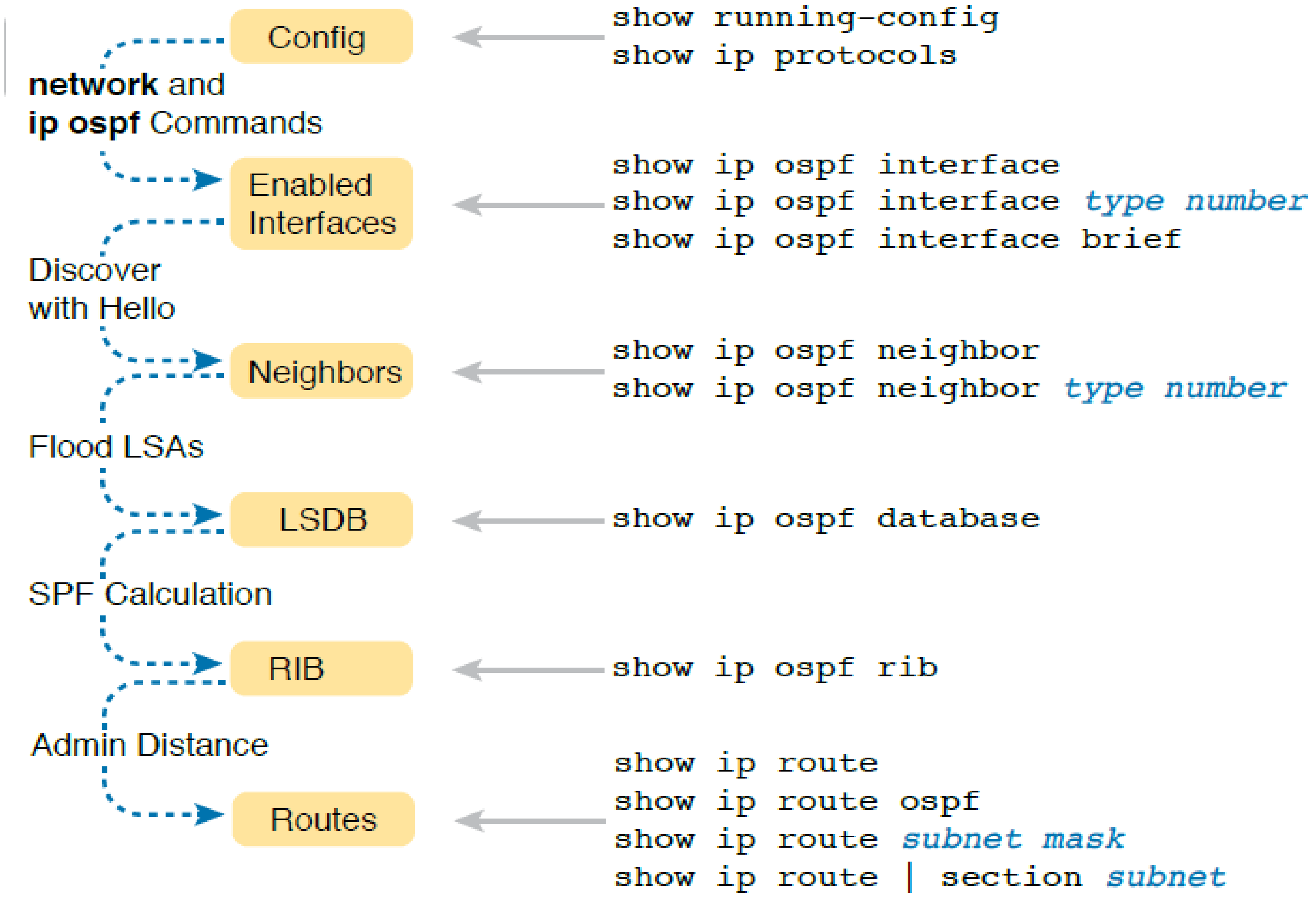
C. Rely on an interface IP address (chooses the highest IP address of all working nonloopbacks).

Step 3. Use one or more **network** *ip-address wildcard-mask* **area** *area-id* router subcommands to enable OSPFv2 on any interfaces matched by the configured address and mask, enabling OSPF on the interface for the listed area.

Practice…



OSPF Verification Commands



Designated & Backup Designated Router

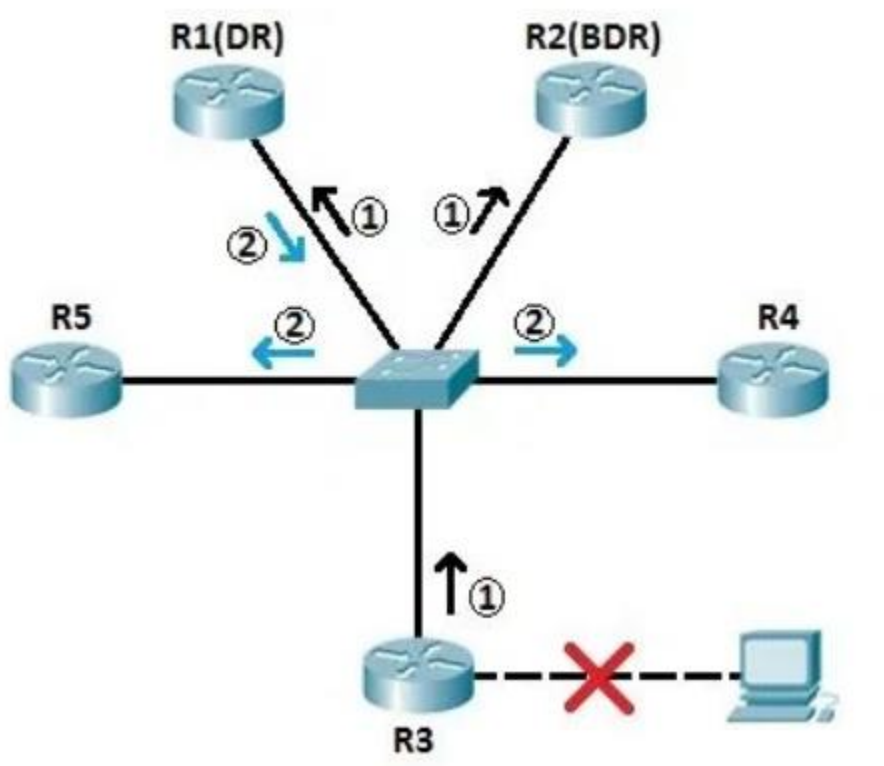
Based on the network type, OSPF router can elect one router to be a Designated Router (DR) and one router to be a Backup Designated Router (BDR). For example, on multiaccess broadcast networks (such as LANs) routers defaults to elect a DR and BDR. DR and BDR serve as the central point for exchanging OSPF routing information. Each non-DR or non-BDR router will exchange routing information only with the DR and BDR, instead of exchanging updates with every router on the network segment. DR will then distribute topology information to every other router inside the same area, which greatly reduces OSPF traffic.

To send routing information to a DR or BDR the multicast address of 224.0.0.6 is used. DR sends routing updates to the multicast address of 224.0.0.5. If DR fails, BDR takes over its role of redistributing routing information.

Every router on a network segment will establish a full neighbor relationship with the DR and BDR. Non-DR and non-BDR routers will establish a two-way neighbor relationship between themselves.

On LANs, DR and BDR have to be elected. Two rules are used to elect a DR and BDR:

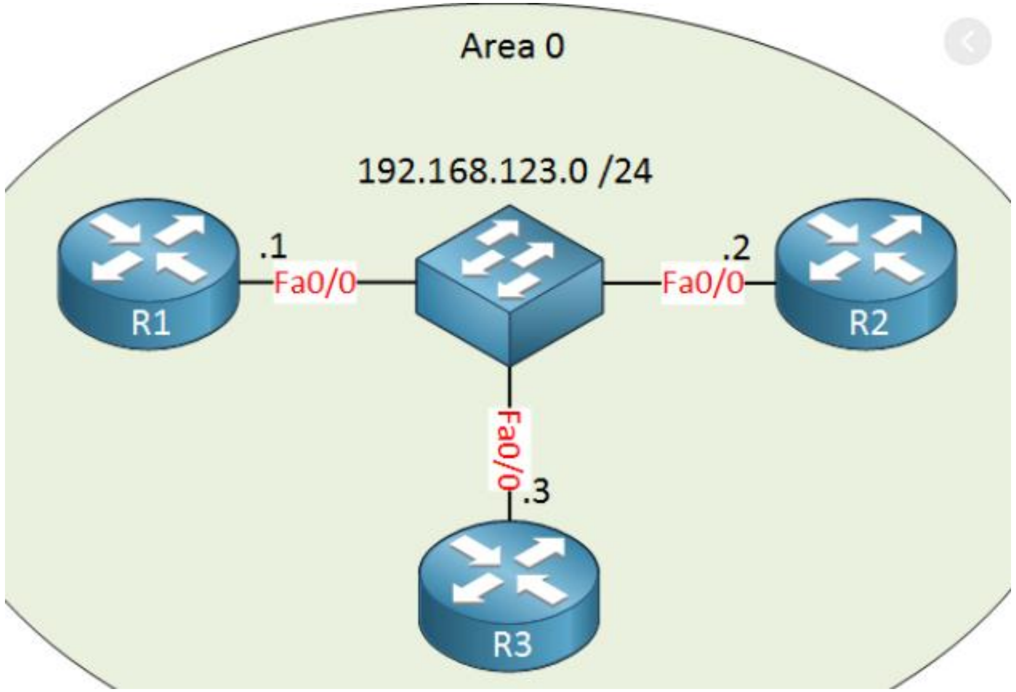
1. router with the highest OSPF priority will become a DR. By default, all routers have a priority of 1.
2. if there is a tie, a router with the highest router ID wins the election. The router with the second highest OSPF priority or router ID will become a BDR.



Designated & Backup Designated Router

- **FULL/ -:** The neighbor state is full, with the “-“ instead of letters meaning that the link does not use a DR/BDR.
- **FULL/DR:** The neighbor state is full, and the neighbor is the DR.
- **FULL/BDR:** The neighbor state is full, and the neighbor is the backup DR (BDR).
- **FULL/DROTHER:** The neighbor state is full, and the neighbor is neither the DR nor BDR. (It also implies that the local router is a DR or BDR because the state is FULL.)
- **2WAY/DROTHER:** The neighbor state is 2-way, and the neighbor is neither the DR no BDR—that is, a DROther router. (It also implies that the local router is also a DROther router because otherwise the state would reach a full state.)

Practice…



OSPF Neighbor States

State	Description
Down	The initial state of a neighbor relationship. It indicates that the router has not received any OSPF hello packets.
Attempt	A state that is relevant to nonbroadcast multi-access (NBMA) networks that do not support broadcast and that require explicit neighbor configuration. This state indicates that no recent information has been received, but the router is still attempting communication.
Init	A state in which a hello packet has been received from another a router, but bidirectional communication has not been established.
2-Way	A state in which bidirectional communication has been established. If a DR or BDR is needed, the election occurs during this state.
ExStart	The first state in forming an adjacency. Routers identify which router will be the master or slave for the LSDB synchronization.
Exchange	A state during which routers are exchanging link states by using DBD packets.
Loading	A state in which LSR packets are sent to the neighbor, asking for the more recent LSAs that have been discovered (but not received) in the Exchange state.
Full	A state in which neighboring routers are fully adjacent.

Configuring the OSPF Router ID

OSPF-speaking routers must have a router ID (RID) for proper operation. By default, routers will choose an interface IP address to use as the RID. However, many network engineers prefer to choose each router’s router ID, so command output from commands like **show ip ospf neighbor** lists more recognizable router IDs.

To choose its RID, a Cisco router uses the following process when the router reloads and brings up the OSPF process. Note that the router stops looking for a router ID to use once one of the steps identifies a value to use.

1. If the **router-id** *rid* OSPF subcommand is configured, this value is used as the RID.

2. If any loopback interfaces have an IP address configured, and the interface has an interface status of up, the router picks the highest numeric IP address among these loopback interfaces.

3. The router picks the highest numeric IP address from all other interfaces whose interface status code (first status code) is up. (In other words, an interface in up/down state will be included by OSPF when choosing its router ID.)

Practice…

OSPF Interface Configuration Steps

After reviewing the traditional configuration, consider this checklist, which details how to convert from the old-style configuration in Examples 20-2 and 20-3 to use interface configuration:

Step 1. Use the **no network** *network-id* **area** *area-id* subcommands in OSPF configuration mode to remove the **network** commands (if configured).

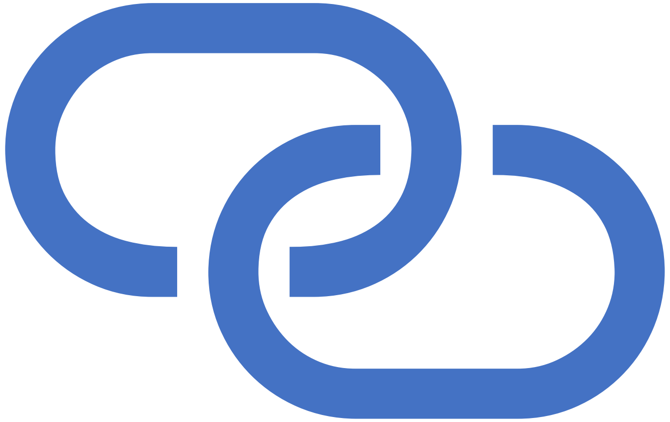
Step 2. Add one **ip ospf** *process-id* **area** *area-id* command in interface configuration mode under each interface on which OSPF should operate, with the correct OSPF process (*process-id*) and the correct OSPF area number.

Practice…

OSPF Passive Interfaces

Sometimes, a router does not need to form neighbor relationships with neighbors on an interface. Often, no other routers exist on a particular link, so the router has no need to keep sending those repetitive OSPF Hello messages. In such cases, an engineer can make the interface passive, which means

- OSPF continues to advertise about the subnet that is connected to the interface.
- OSPF no longer sends OSPF Hellos on the interface.
- OSPF no longer processes any received Hellos on the interface.



The result of enabling OSPF on an interface but then making it passive is that OSPF still advertises about the connected subnet, but OSPF also does not form neighbor relationships over the interface.

To configure an interface as passive, two options exist. First, you can add the following command to the configuration of the OSPF process, in router configuration mode:

- **passive-interface** *type number*

Alternately, the configuration can change the default setting so that all interfaces are passive by default and then add a **no passive-interface** command for all interfaces that need to not be passive:

- **passive-interface default**
- **no passive-interface** *type number*

Practice…

OSPF Metrics (Cost)

Cost = Reference_bandwidth / Interface_bandwidth.

Cisco routers allow three different ways to change the OSPF interface cost:

- Directly, using the interface subcommand **ip ospf cost** *x*.
- Using the default calculation per interface, and changing the *interface bandwidth* setting, which changes the calculated value.
- Using the default calculation per interface, and changing the OSPF *reference bandwidth* setting, which changes the calculated value.

Practice…

Interface	Interface Default Bandwidth (Kbps)	Formula (Kbps)	OSPF Cost
Serial	1544 Kbps	100,000 / 1544	64
Ethernet	10,000 Kbps	100,000 / 10,000	10
Fast Ethernet	100,000 Kbps	100,000/100,000	1
Gigabit Ethernet	1,000,000 Kbps	100,000/1,000,000	1
10 Gigabit Ethernet	10,000,000 Kbps	100,000/10,000,000	1
100 Gigabit Ethernet	100,000,000 Kbps	100,000/100,000,000	1

That is all for Lesson 21

The key is :

Learn

Repeat

Practice

You will be able to reach your goals.

GOOD LUCK !!!!!...