Lab 6: Basics of Redistribution, Configure OSPF on a multi-access network

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Objectives:

- ✓ Understanding the basics of redistribution between routing protocols
- ✓ Learning and understanding how to enable OSPF on point-to-multipoint Non-Broadcast or Broadcast network types.
- ✓ Configuring OSPF routing parameters

Content:

I. Redistribution

1. Introduction

The use of a routing protocol to advertise routes that are learned by some other means, such as by another routing protocol, static routes, or directly connected routes, is called redistribution. While running a single routing protocol throughout your entire IP internetwork is desirable, multi-protocol routing is common for a number of reasons, such as company mergers, multiple departments managed by multiple network administrators, and multi-vendor environments. Running different routing protocols is often part of a network design. In any case, having a multiple protocol environment makes redistribution a necessity.

Differences in routing protocol characteristics, such as metrics, administrative distance, classful and classless capabilities can effect redistribution. Consideration must be given to these differences for redistribution to succeed.

2. Metrics

When you redistribute one protocol into another, remember that the metrics of each protocol play an important role in redistribution. Each protocol uses different metrics. For example, the Routing Information Protocol (RIP) metric is based on hop count, but Interior Gateway

Routing Protocol (IGRP) and Enhanced Interior Gateway Routing Protocol (EIGRP) use a composite metric based on bandwidth, delay, reliability, load, and maximum transmission unit (MTU), where bandwidth and delay are the only parameters used by default. When routes are redistributed, you must define a metric that is understandable to the receiving protocol. There are two methods to define metrics when redistributing routes.

You can define the metric for that specific redistribution only:

```
router rip
redistribute static metric 1
redistribute ospf 1 metric 1
```

Or you can use the same metric as a default for all redistribution (Using the **default-metric** command saves work because it eliminates the need for defining the metric separately for each redistribution.):

```
router rip
redistribute static
redistribute ospf 1
default-metric 1
```

3. Administrative Distance

If a router is running more than one routing protocol and learns a route to the same destination using both routing protocols, then which route should be selected as the best route? Each protocol uses its own metric type to determine the best route. Comparing routes with different metric types cannot be done. Administrative distances take care of this problem. Administrative distances are assigned to route sources so that the route from the most preferred source will be chosen as the best path.

4. Redistribution Configuration Syntax on Cisco Routers

IGRP and EIGRP

This output shows an IGRP/EIGRP router redistributing static, Open Shortest Path First (OSPF), RIP, and Intermediate System-to-Intermediate System (IS-IS) routes.

```
router igrp/eigrp 1
network 131.108.0.0
redistribute static
redistribute ospf 1
redistribute rip
redistribute isis
default-metric 10000 100 255 1 1500
```

IGRP and EIGRP need five metrics when redistributing other protocols: bandwidth, delay, reliability, load, and MTU, respectively. An example of IGRP metrics follows:

Metric	Value
bandwidth	In units of kilobits per second; 10000 for Ethernet
delay	In units of tens of microseconds; for Ethernet it is100 x 10 microseconds = 1 ms
reliability	255 for 100 percent reliability
load	Effective load on the link expressed as a number from 0 to 255 (255 is 100 percent loading)
MTU	Minimum MTU of the path; usually equals that for the Ethernet interface, which is 1500 bytes

OSPF

This output shows an OSPF router redistributing static, RIP, IGRP, EIGRP, and IS-IS routes.

```
router ospf 1
network 131.108.0.0 0.0.255.255 area 0
redistribute static metric 200 subnets
redistribute rip metric 200 subnets
redistribute igrp 1 metric 100 subnets
redistribute eigrp 1 metric 100 subnets
redistribute isis metric 10 subnets
```

The OSPF metric is a cost value based on 108/ bandwidth of the link in bits/sec. For example, the OSPF cost of Ethernet is 10: 108/107 = 10

Note: If a metric is not specified, OSPF puts a default value of 20 when redistributing routes from all protocols except Border Gateway Protocol (BGP) routes, which get a metric of 1.

When there is a major net that is subnetted, you need to use the keyword subnet to redistribute protocols into OSPF. Without this keyword, OSPF only redistributes major nets that are not subnetted.

It is possible to run more than one OSPF process on the same router. However, running more than one process of the same protocol is rarely needed, and consumes the router's memory and CPU.

You do not need to define metric or use the default-metric command when redistributing one OSPF process into another.

RIP

Note: The principles in this document apply to RIP versions I and II.

This output shows a RIP router redistributing static, IGRP, EIGRP, OSPF, and IS-IS routes.

```
router rip
network 131.108.0.0
redistribute static
redistribute igrp 1
redistribute eigrp 1
redistribute ospf 1
redistribute isis
default-metric 1
```

The RIP metric is composed of hop count, and the maximum valid metric is 15. Anything above 15 is considered infinite; you can use 16 to describe an infinite metric in RIP.

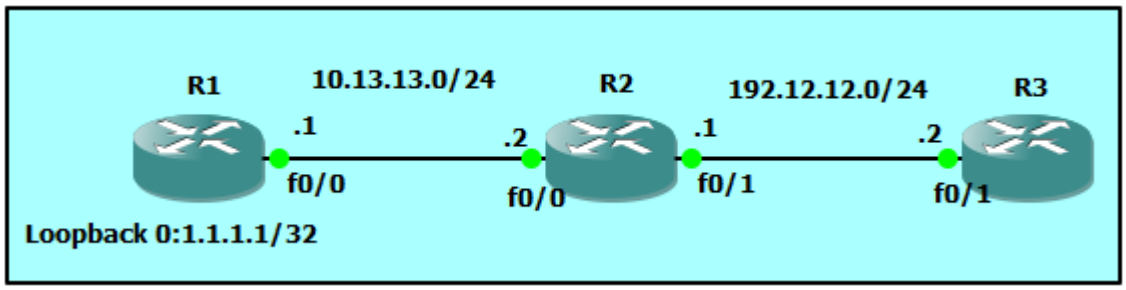
IS-IS

This output shows an IS-IS router redistributing static, RIP, IGRP, EIGRP, and OSPF routes.

```
router isis
network 49.1234.1111.1111.1111.00
redistribute static
redistribute rip metric 20
redistribute igrp 1 metric 20
redistribute eigrp 1 metric 20
redistribute ospf 1 metric 20
```

The IS-IS metric must be between 1 and 63. If no metric is specified for the routes being redistributed into IS-IS, a metric value of 0 is used by default.

Example:



This example illustrates Redistributing Static Route into RIP routing protocol. As per the topology, we have three routers (R1, R2, and R3). R2 and R3 have RIP configured on interface Fast Ethernet 0/1. R2 has a static route to reach the Lo 0 interface (ip address 1.1.1.1/32) of Router R1. This static route is redistributed in RIP routing protocol. Router R1 is configured with a default route .

```
R1(config)# ip route 0.0.0.0 0.0.0.0 FastEthernet 0/0
R2(config)# ip route 1.1.1.1 255.255.255.255 10.13.13.1
R2(config)# router rip
R2(config-router) redistribute static metric 10
```

On Router R3, route 1.1.1.1 can be seen via the **show ip route** command:

```
C    192.12.12.0/24 is directly connected, FastEthernet0/1
R    1.0.0.0/8 [120/10] via 192.12.12.1, 00:00:07, FastEthernet0/1
```

Practice 1: Create the topology in the above example and check the result. Then, replace static route by EIGRP and redo the redistribution.

II. Open Shortest Path First

OSPF Configuration Task List

OSPF typically requires coordination among many **Internal Routers (IR)**, **Area Border Routers (ABR)**, and **Autonomous System Boundary Routers (ASBR)**. At a minimum, OSPF-based routers or access servers can be configured with all default parameter values, no authentication, and interfaces assigned to areas.

1. Enable OSPF

As with other routing protocols, enabling OSPF requires that you create an OSPF routing process, specify the range of IP addresses to be associated with the routing process, and assign area IDs to be associated with that range of IP addresses.

Step	Command	Purpose
1	router ospf process-id	Enable OSPF routing, which places you in router configuration mode.
2	network address wildcard-mask area area-id	Define an interface on which OSPF runs and define the area ID for that interface.

2. Configure OSPF Interface Parameters

Be sure that if you do configure any of these parameters, the configurations for all routers on your network have compatible values. In interface configuration mode, use any of the following commands to specify interface parameters as needed for your network:

Command	Purpose
ip ospf cost cost	Explicitly specify the cost of sending a packet on an OSPF interface.
ip ospf retransmit-interval seconds	Specify the number of seconds between link state advertisement retransmissions for adjacencies belonging to an OSPF interface.
ip ospf transmit-delay seconds	Set the estimated number of seconds it takes to transmit a link state update packet on an OSPF interface.
ip ospf priority number	Set priority to help determine the OSPF designated router for a network.
ip ospf hello-interval seconds	Specify the length of time between the hello packets that the Cisco IOS software sends on an OSPF interface.
ip ospf dead-interval seconds	Set the number of seconds that a device's hello packets must not have been seen before its neighbors declare the OSPF router down.
ip ospf authentication-key key	Assign a password to be used by neighboring OSPF routers on a network segment that is using

	OSPF's simple password authentication.
ip ospf message-digest-key keyid md5 key	Enable OSPF MD5 authentication.
ip ospf authentication[**message-digest** | **null]**	Specifies the authentication type for an interface.

3. Configure OSPF over Different Physical Networks

OSPF classifies different media into the following three types of networks by default:

- Broadcast networks (Ethernet, Token Ring, FDDI)
- Non-broadcast multiaccess networks (SMDS, Frame Relay, X.25)
- Point-to-point networks (HDLC, PPP)

a. Configure Your OSPF Network Type

You have the choice of configuring your OSPF network type as either broadcast or nonbroadcast multiaccess, regardless of the default media type. Using this feature, you can configure broadcast networks as nonbroadcast multiaccess networks when, for example, you have routers in your network that do not support multicast addressing. You also can configure nonbroadcast multiaccess networks (such as X.25, Frame Relay, and SMDS) as broadcast networks. This feature saves you from having to configure neighbors.

Configuring nonbroadcast, multiaccess networks as either broadcast or nonbroadcast assumes that there are virtual circuits from every router to every router or fully meshed network. This is not true for some cases, for example, because of cost constraints, or when you have only a partially meshed network. In these cases, you can configure the OSPF network type as a point-to-multipoint network. Routing between two routers not directly connected will go through the router that has virtual circuits to both routers.

An OSPF point-to-multipoint interface is defined as a numbered point-to-point interface having one or more neighbors. It creates multiple host routes. An OSPF point-to-multipoint network has the following benefits compared to nonbroadcast multiaccess and point-to-point networks:

- Point-to-multipoint is easier to configure because it requires no configuration of neighbor commands, it consumes only one IP subnet, and it requires no designated router election.
- It costs less because it does not require a fully meshed topology.
- It is more reliable because it maintains connectivity in the event of virtual circuit failure.

To configure your OSPF network type, use the following command in interface configuration mode:

Command	**Purpose**
ip ospf network {broadcast | non-broadcast | {point-to-multipoint [non-broadcast] }}	Configure the OSPF network type for a specified interface.

b. Configure Point-to-Multipoint, Broadcast Networks

To treat an interface as point-to-multipoint broadcast and assign a cost to each neighbor, use the following commands beginning in interface configuration mode:

Step	Command	Purpose
1	**ip ospf network point-to-multipoint**	Configure an interface as point-to-multipoint for broadcast media.
2	**exit**	Enter global configuration mode.
3	router ospf process-id	Configure an OSPF routing process and enter router configuration mode.
4	neighbor ip-address cost number	Specify a neighbor and assign a cost to the neighbor.
5		Repeat Step 4 for each neighbor if you want to specify a cost. Otherwise, neighbors will assume the cost of the interface, based on the ip ospf cost command.

c. Configure OSPF for Nonbroadcast Networks

To configure routers that interconnect to nonbroadcast networks, use the following command in router configuration mode:

Command	Purpose
neighbor ip-address [priority number] [poll-interval seconds]	Configure a router interconnecting to nonbroadcast networks.

You can specify the following neighbor parameters, as required:

- Priority for a neighboring router
- Nonbroadcast poll interval
- Interface through which the neighbor is reachable

On point-to-multipoint, nonbroadcast networks, you now use the neighbor command to identify neighbors. Assigning a cost to a neighbor is optional.

To treat the interface as point-to-multipoint when the media does not support broadcast, use the following commands beginning in interface configuration mode:

Step	Command	Purpose
1	**ip ospf network point-to-multipoint non-broadcast**	Configure an interface as point-to-multipoint for nonbroadcast media.
2	**exit**	Enter global configuration mode.
3	router ospf process-id	Configure an OSPF routing process and enter router configuration mode.
4	neighbor ip-address [cost number]	Specify an OSPF neighbor and optionally assign a cost to the neighbor.
5		Repeat Step 4 for each neighbor.

4. Configure OSPF Area Parameters

Command	Purpose
area area-id authentication	Enable authentication for an OSPF area.
area area-id authentication message-digest	Enable MD5 authentication for an OSPF area.
area area-id stub [no-summary]	Define an area to be a stub area.
area area-id default-cost cost	Assign a specific cost to the default summary route used for the stub area.

a. Configure OSPF Not So Stubby Area (NSSA)

In router configuration mode, use the following command to specify area parameters as needed to configure OSPF NSSA:

Command	Purpose
area area-id nssa [no-redistribution] [**default-information-originate**]	Define an area to be NSSA.

In router configuration mode on the ABR, use the following command to control summarization and filtering of Type 7 LSA into Type 5 LSA:

Command	Purpose
summary address prefix mask [not advertise] [**tag** tag]	(Optional) Control the summarization and filtering during the translation.

b. Configure Route Summarization between OSPF Areas

Route summarization is the consolidation of advertised addresses. This feature causes a single summary route to be advertised to other areas by an ABR. If the network numbers in an area are assigned in a way such that they are contiguous, you can configure the ABR to advertise a summary route that covers all the individual networks within the area that fall into the specified range.

To specify an address range, use the following command in router configuration mode:

Command	Purpose
area area-id range address mask [**advertise**|**not-advertise]**	Specify an address range for which a single route will be advertised.

c. Configure Route Summarization when Redistributing Routes into OSPF

To have the software advertise one summary route for all redistributed routes covered by a network address and mask, use the following command in router configuration mode:

Command	Purpose
summary-address address mask	Specify an address and mask that covers redistributed routes, so only one summary route is advertised.

5. Create Virtual Links (Optional)

To establish a virtual link, use the following command in router configuration mode:

Command	Purpose
area area-id virtual-link router-id [authentication [message-digest | null]] [hello-interval seconds] [retransmit-interval seconds] [transmit-delay seconds] [dead-interval seconds] [[authentication-key key] | [message-digest-key keyid md5 key]]	Establish a virtual link.

6. Generate a Default Route

To force the autonomous system boundary router to generate a default route, use the following command in router configuration mode:

Command	Purpose
default-information originate [always] [metric metric-value] [metric-type type-value] [route-map map-name]	Force the autonomous system boundary router to generate a default route into the OSPF routing domain.

7. Configure Lookup of DNS Names

To configure DNS name lookup, use the following command in global configuration mode:

Command	Purpose
ip ospf name-lookup	Configure DNS name lookup.

8. Force the Router ID Choice with a Loopback Interface

To configure an IP address on a loopback interface, use the following commands, starting in global configuration mode:

Step	Command	Purpose
1	**interface loopback 0**	Create a loopback interface, which places you in interface configuration mode.
2	ip address address mask	Assign an IP address to this interface.

9. Control Default Metrics

Command	Purpose
ospf auto-cost reference-bandwidth ref-bw	Differentiate high bandwidth links.

10. Change the OSPF Administrative Distances

Command	Purpose
distance ospf {[intra-area dist1] [inter-area dist2] [external dist3]}	Change the OSPF distance values.

11. Configure OSPF on Simplex Ethernet Interfaces

Command	Purpose
passive-interface type number	Suppress the sending of hello packets through the specified interface.

12. Configure Route Calculation Timers

Command	Purpose

timers spf spf-delay spf-holdtime	Configure route calculation timers.

13. Log Neighbors Going Up or Down

To configure the router to send a syslog message when an OSPF neighbor goes up or down, use the following command in router configuration mode:

Command	Purpose
ospf log-adjacency-changes	Send syslog message when an OSPF neighbor goes up or down.

14. Change the LSA Group Pacing

The default value of pacing between LSA groups is 240 seconds (4 minutes). The range is 10 seconds to 1800 seconds (half an hour). To change the LSA group pacing interval, use the following command in router configuration mode:

Command	Purpose
timers lsa-group-pacing seconds	Change the group pacing of LSAs.

15. Block OSPF LSA Flooding

On broadcast, nonbroadcast, and point-to-point networks, to prevent flooding of OSPF LSAs, use the following command in interface configuration mode:

Command	Purpose
ospf database-filter all out	Block the flooding of OSPF LSA packets to the interface.

On point-to-multipoint networks, to prevent flooding of OSPF LSAs, use the following command in router configuration mode:

Command	Purpose
neighbor ip-address database-filter all out	Block the flooding of OSPF LSA packets to the specified neighbor.

16. Monitor and Maintain OSPF

You can display specific statistics such as the contents of IP routing tables, caches, and databases. Information provided can be used to determine resource utilization and solve network problems. You can also display information about node reachability and discover the routing path your device's packets are taking through the network.

To display various routing statistics, use the following commands in EXEC mode:

Command	Purpose
show ip ospf [process-id]	Display general information about OSPF routing processes.
show ip ospf [process-id area-id] database show ip ospf [process-id area-id] database [router] [link-state-id] show ip ospf [process-id area-id] database [router] [self-originate] show ip ospf [process-id area-id] database [router] [adv-router [ip-address]] show ip ospf [process-id area-id] database [network] [link-state-id] show ip ospf [process-id area-id] database [summary] [link-state-id] show ip ospf [process-id area-id] database [asbr-summary] [link-state-id] show ip ospf [process-id] database [external] [link-state-id] show ip ospf [process-id area-id] database [database-summary]	Display lists of information related to the OSPF database.
show ip ospf border-routers	Display the internal OSPF routing table entries to Area Border Router (ABR) and Autonomous System Boundary Router (ASBR).
show ip ospf interface [interface-name]	Display OSPF-related interface information.
show ip ospf neighbor [interface-name] [neighbor-id] detail	Display OSPF-neighbor information on a per-interface basis.
show ip ospf request-list [nbr] [intf] [intf-nbr]	Display a list of all LSAs requested by a router.
show ip ospf retransmission-list [nbr] [intf] [intf-nbr]	Display a list of all LSAs waiting to be retransmitted.
show ip ospf virtual-links	Display OSPF-related virtual links information.

Practice 2:

Create the network topology in the picture below.

- Configure OSPF on all routers, using whatever process ID you wish.
- Each step in OSPF configuration task, you have to use some commands of OSPF debug commands to show or troubleshoot the consequence.
- Test connectivity of the network by pinging from one LAN to another.
- Check out OSPF Configuration Examples in the link given.

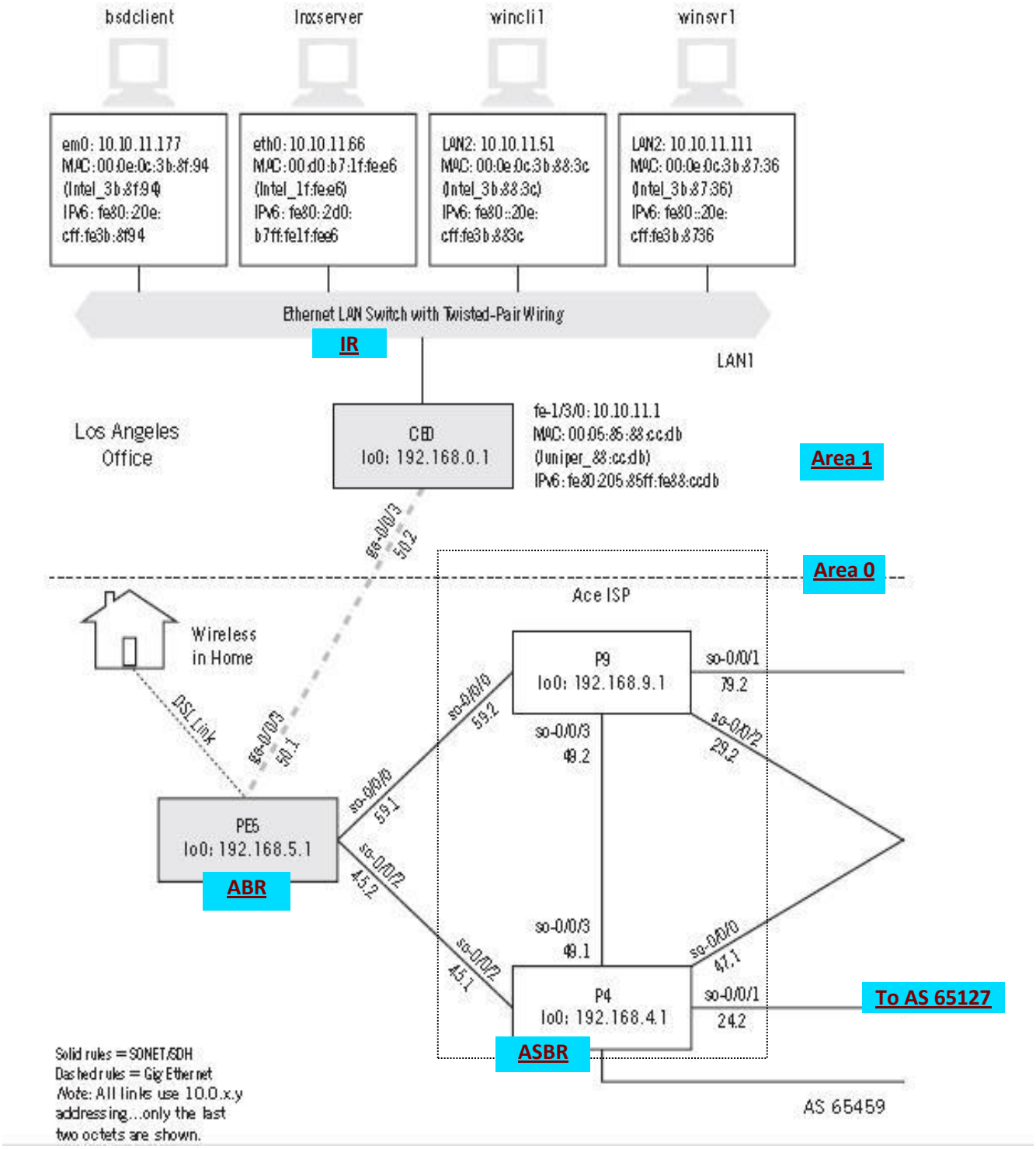
OSPF Configuration Task List

To configure OSPF, complete the tasks in the following sections. Enabling OSPF is mandatory; the other tasks are optional, but might be required for your application.

In case of Lab time limit, you just try to experience some tasks.

- Enable OSPF; on all routers
- Configure OSPF Interface Parameters
- Configure OSPF over Different Physical Networks
- Configure OSPF Area Parameters
- Configure OSPF Not So Stubby Area (NSSA)
- Configure Route Summarization between OSPF Areas
- Configure Route Summarization when Redistributing Routes into OSPF
- Create Virtual Links
- Generate a Default Route: from stub Area 1 to Area 0
- Configure Lookup of DNS Names
- Force the Router ID Choice with a Loopback Interface
- Control Default Metrics
- Change the OSPF Administrative Distances to 200
- Configure OSPF on Simplex Ethernet Interfaces on some interfaces of your choice
- Configure Route Calculation Timers
- Log Neighbors Going Up or Down
- Change the LSA Group Pacing
- Block OSPF LSA Flooding
- Monitor and Maintain OSPF with your configuration

Network Layout:



III. Submission

Finish practice1, 2 on GNS3. Compress all the project into Lab6_<student_code>.zip and submit this file onto Sakai.

References

http://www.cisco.com/c/en/us/support/docs/ip/enhanced-interior-gateway-routing-protocol-eigrp/8606-redist.html

http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/iproute_ospf/configuration/12-4t/iro-12-4t-book/iro-cfg.html

http://www.cisco.com/en/US/tech/tk365/technologies_white_paper09186a0080094e9e.shtml#t28