Configuring the OSPF Routing Process

Objective
- Setup an IP addressing scheme for OSPF area 0.
- Configure and verify Open Shortest Path First (OSPF) Routing.
- Modify OSPF cost metric on an interface

Theory
The Open Shortest Path First (OSPF) protocol is a link-state, hierarchical interior gateway protocol (IGP) for network routing. Dijkstra's algorithm is used to calculate the shortest path tree. It uses cost as its routing metric. A link state database is constructed of the network topology which is identical on all routers in the area. OSPF does not use TCP or UDP but uses IP directly, via IP protocol 89.

An OSPF network can be broken up into smaller networks. A special area called the backbone area forms the core of the network, and other areas are connected to it. Inter-area routing goes via the backbone. All areas must connect to the backbone; if no direct connection is possible, a virtual link may be established. Several "special" area types are defined:

**Backbone area**
The backbone area (also known as area zero) forms the core of an OSPF network. All other areas are connected to it, and inter-area routing happens via a router connected to the backbone area. It is the logical and physical structure for the 'autonomous system' (AS) and is attached to multiple areas. The backbone area is responsible for distributing routing information between non-backbone areas. The backbone must be contiguous, but it does not need to be physically contiguous; backbone connectivity can be established and maintained through the configuration of virtual links.

**Note:** All OSPF areas must connect to the backbone area.

**Stub area**
A stub area is an area which does not receive external routes. External routes are defined as routes which were distributed in OSPF from another routing protocol. Therefore, stub areas typically need to rely on a default route to send traffic to routes outside the present domain. This implies that AS-external routes (Type 5 LSAs) are not fed into Stub Areas.

**Totally stubby area**
A totally stubby area (TSA) is similar to a stub area, however this area does not allow summary routes in addition to the external routes, that is, inter-area (IA) routes are not summarized into totally stubby areas. The only way for traffic to get routed outside of the area is a default route which is the only Type-3 LSA advertised into the area. When there is only one route out of the area, fewer routing decisions have to be made by the route processor, which lowers system resource utilization.

**Not-so-stubby area**
A not-so-stubby area (NSSA) is a type of stub area that can import autonomous system (AS) external routes and send them to the backbone, but cannot receive AS external routes from the backbone or other areas. Cisco also implements a proprietary version of a NSSA called a NSSA totally stubby area. It takes on the attributes of a TSA, meaning that type 3 and type 4 summary routes are not flooded into this type of area.
Background/Preparation
Routing between the ISP and the campus router uses a static route between the ISP and the gateway router, and a default route between the gateway router and the ISP router. The ISP connection to the Internet is identified by a loopback address on the ISP router.

Equipment required for each group
If your class has 10 or less students you may work in pairs, otherwise work in groups of three.

- Two additional straight through network cables per group.
- One DTE/smart serial cable and one DCE/smart serial cable per group.
- One crossover cable per group.
- One console (Rollover) cable per group.
- One Cisco switch per group.
- Two Cisco routers per group.

Cable a network similar to the one in the diagram below. Please refer to the handout to correctly identify the interface identifiers to be used based on the equipment in the lab. The configuration output used in this exercise is produced from 1721 series Cisco routers. Any other router used may produce slightly different output. Conduct the following steps on each router unless specifically instructed otherwise.

<table>
<thead>
<tr>
<th>Router Designation</th>
<th>Router Name</th>
<th>Enable Secret Password</th>
<th>Enable VTY and Console Passwords</th>
<th>Routing Protocol</th>
<th>Network Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router 1</td>
<td>London</td>
<td>class</td>
<td>cisco</td>
<td>OSPF</td>
<td>192.168.1.0</td>
</tr>
<tr>
<td>Router 2</td>
<td>Moscow</td>
<td>class</td>
<td>cisco</td>
<td>OSPF</td>
<td>192.168.1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Router Designation</th>
<th>IP Host Table Entry</th>
<th>FastEthernet 0 Address/subnet Mask</th>
<th>Interface Type</th>
<th>Serial Address/Subnet Mask</th>
<th>0 Interface Type Serial 1</th>
<th>Serial1 Address/subnet mask</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router 1</td>
<td>Moscow</td>
<td>192.168.1.129/26</td>
<td>DCE</td>
<td>192.168.1.1/30</td>
<td>NA</td>
<td>No Address</td>
</tr>
<tr>
<td>Router 2</td>
<td>London</td>
<td>NA</td>
<td>DTE</td>
<td>172.16.1.5/30</td>
<td>NA</td>
<td>No Address</td>
</tr>
</tbody>
</table>
**Procedure**
Start a HyperTerminal session.

**Reset the routers: Erasing and reloading the router**

*Note:* You must perform these steps on all routers in this lab exercise before continuing.

*Note:* Please refer to the meaning and structure of the command syntax provided at the end of the exercise.

**Step 1:** Enter into the global configuration mode (privileged EXEC mode) by typing the following:

```
Router> enable
```

**Step 2:** At the privileged EXEC mode, enter the following command:

```
Router# erase startup-config
```

The responding prompt will be:

**Erasing the nvram filesystem will remove all files! Continue? [confirm]**

Press **Enter** to confirm.

The response should be:

**Erase of nvram: complete**

**Step 3:** Now at the privileged EXEC mode, enter the following command:

```
Router# reload
```

The responding prompt line will be:

**System configuration has been modified. Save? [yes/no]: n**

**Proceed with reload? [confirm]**

Press **Enter** to confirm.

The Corresponding line prompt will be:

**Proceed with reload? [confirm]**

Press **Enter** to confirm.

In the first line of the response will be:

**Reload requested by the console.**
After the router has reloaded, the line prompt will be:

Would you like to enter the initial configuration dialog?
    [yes/no]: n

If you are asked...
Would you like to terminate autoinstall? [yes]: y

The responding line prompt will be:

Press Return to get started!

Press Enter.

Now the router is ready for the assigned lab exercise to be performed.

Step 1: Configure the routers.
On the routers, enter into the global configuration mode and configure:
  • The hostname.
  • The console.
  • The virtual terminal.
  • The enable passwords.
Next configure the interfaces and IP hostnames according to the chart. Do not configure
the routing protocol until specifically told to.

Connect the network
  • Connect the network cables.
  • Power-up the switches.
  • Reset the switches

Step 2: Save the configuration.
Enter into the global configuration mode by typing the following command:
Router> enable

At the privileged EXEC mode prompt, on both routers, type the command:

London# copy running-config startup-config
Destination filename [startup-config]?[Enter]
Moscow# copy running-config startup-config
Destination filename [startup-config]?[Enter]

Step 3: Configure the hosts with the proper IP address, subnet mask, and default
gateway.
Each workstation must be able to ping to the attached router. Remember to assign a specific IP address and default gateway to the workstation. If running Windows 2000 or higher, check using `ipconfig` in the command prompt (DOS window). At this point the workstations will not be able to communicate with each other. The following steps will demonstrate the process required to get communication working using OSPF as the area routing protocol.

**Step 4: View the router configuration and interface information.**

At the privileged EXEC mode type:

**London# show running-config**

The running configuration file contains the currently operating configuration file. Use the `show running-config` command with no arguments to display the entire current configuration file.

**London# show ip interface brief**

This command is used to check the status on each interface.

**Observations:** What is the state of the interfaces of each router?

**London**
- Fast Ethernet 0:
- Serial 0:

**Moscow**
- Fast Ethernet 0:
- Serial 0:

On a router, ping the serial interface of the other router.

Was the Ping successful? (Y/N):

If the ping was not successful, troubleshoot the router configuration, until the ping is successful.

**Step 5: Configure OSPF routing on router London.**

**Step 5.1: Configure OSPF routing on each router.** Use OSPF process number 1 and ensure all networks are in area 0.

**London(config)#router ospf 1**

Displays summary information regarding the global OSPF configuration along with the identifier of the OSPF process as defined by the router OSPF command.

**London(config-router)#network 192.168.1.128 0.0.0.63 area 0**

Use this command to enable OSPF on the specified interface address or range of addresses.
The network area command enables OSPF to operate on an interface if the interface's address is included in the address range specified by the command. If the interface's address is not covered by the address range specified by the network area command, OSPF will not be enabled on the interface.

The wildcard-bits are the inverse of the network mask used to further define the network address. For example, if the network address mask is 255.255.255.0, the wildcard-bits is 0.0.0.255. The address and wildcard-bits allow you to specify a single interface or multiple interfaces.

The ip-address and wildcard-bits together define the interfaces on which to run OSPF. If none of the interfaces defined on this router fall within the network area, OSPF does not run on any interfaces.

NOTE: An interface may be associated with only one network area.

```
London(config-router)#network 192.168.1.0 0.0.0.3 area 0
London(config-router)#end
```

Step 5.2: Examine the running configuration file.

Observations
Did the IOS version automatically add any lines under router OSPF 1?(Y/N)
What did it add?...
If there are no changes in the running configuration, type the following commands:

```
London(config)#router ospf 1
London(config-router)#log-adjacency-changes
```

This command Enables/disables logging of adjacency change notices. This command instructs the router to create a log message whenever two OSPF routers establish or break their adjacency relationship. By default, adjacency changes reported by the router are not displayed on the console.

```
London(config-router)#end
```

Step 5.3: Show the routing table for the London router.

```
London#show ip route
```

Displays the entire IP route table, a summary of the routing table or route information for specific IP addresses, network masks or protocols. Use the show ip route command with no arguments to display all IP routes.

Observations
Are there any entries in the routing table? Why?
Add a default route from the gateway router to the ISP router. This will forward any unknown destination address traffic to the ISP.
At the gateway router, enter into the global configuration mode by typing in the following command:

**Step 6: Configure OSPF routing on router Moscow.**
**Step 6.1: Configure OSPF routing on each router. Use OSPF process number 1 and ensure all networks are in area 0.**

```
Moscow(config)#router ospf 1
Moscow(config-router)#network 192.168.0.0 0.0.0.255 area 0
Moscow(config-router)#network 192.168.1.0 0.0.0.3 area 0
Moscow(config-router)#end
```

**Step 6.2: Examine the running configuration file.**
Did the IOS version automatically add any lines under router OSPF 1?(Y/N)
What did it add?...
If there are no changes in the running configuration, type the following commands:

```
Moscow(config)#router ospf 1
```
This command initializes the OSPF process.

```
Moscow(config-router)#log-adjacency-changes
```

```
Moscow(config-router)#end
```

**Step 6.3: Show the routing table for the Moscow router.**

```
Moscow#show ip route
```

**Observations**
Are there any entries in the routing table? Why?

**Step 7: Show the routing table entries.**

```
London#show ip route
```

**Observations:**
Are there any OSPF entries in the routing table now?

`Ans.`
What is the metric value of the OSPF route?

`Ans.`
What is the VIA address in the OSPF broute?

`Ans.`
Are routes to all networks shown in the routing table?

Ans.

What does the O mean in the first column of the routing table?

Ans.

Step 8: Test Network connectivity.
Ping the London host from the Moscow host. Was it successful?
If not troubleshoot as necessary?

Step 9: Look at the OSPF cost on the London router interface.
Step 9.1 Show the properties of the London router serial and FastEthernet interfaces.
Type in the following command:

London# show interfaces.

Observations
What is the default bandwidth of the interfaces?
- Serial interface:
- FastEthernet interface:

Calculate the OSPF cost.
- Serial interface:
- FastEthernet interface:

Step 10: Record the OSPF cost of the serial and FastEthernet interfaces.
Step 10.1: Record the OSPF cost of the serial and FastEthernet interfaces.
Type in the following command:

London# show ip ospf interface

This command displays all the interface-related OSPF information. Information includes the interface IP address, area assignment, Process ID, Router ID, network type, cost, Priority, DR, BDR, time intervals and adjacent neighbor information.

Observations
OSPF cost of Serial interface:
OSPF cost of FastEthernet interface:
Do these agree with the calculations?

Step 11: Manually set the cost on the serial interfaces.
On the serial interface of the London router, set the OSPF cost to 1562 by using the following command at the serial interface configuration mode prompt:

London(config-seral)#ip ospf cost 1562
Step 12: Verify the cost.
Note: It is essential that all connected links agree about the cost for consistent calculation of the shortest path first (SPF) algorithm in an area.
Verify that the interface OSPF cost was successfully modified.
Reverse the effect of this command by entering in interface configuration mode the following command:

London(config-serial)#no ip ospf cost 1562

This command is used to specify the cost of sending a packet on an interface.

Verify that the default cost for the interface has returned.
Enter the following command at the serial 0 interface configuration mode.

**Bandwidth 2000**

Use the `bandwidth` command to define the bandwidth for a link.
Bandwidth refers to the number of bits per second that can be routed through a link.

Record the new OSPF cost of the serial interface.

**Observations**
Can the OSPF cost of an Ethernet interface be modified in this way?
Ans.
The speed can be set on an Ethernet Interface. Will this affect the OSPF cost of that interface?
Verify and explain the above answer.
Ans.
Reset the bandwidth on the serial interface using the following command at the serial 0 interface configuration mode.

London(config-serial)#No bandwidth 2000.

Once previous steps are completed, log off by typing exit, and turn the router off. Then remove and store the cables and adapters.