OSPF Assignment

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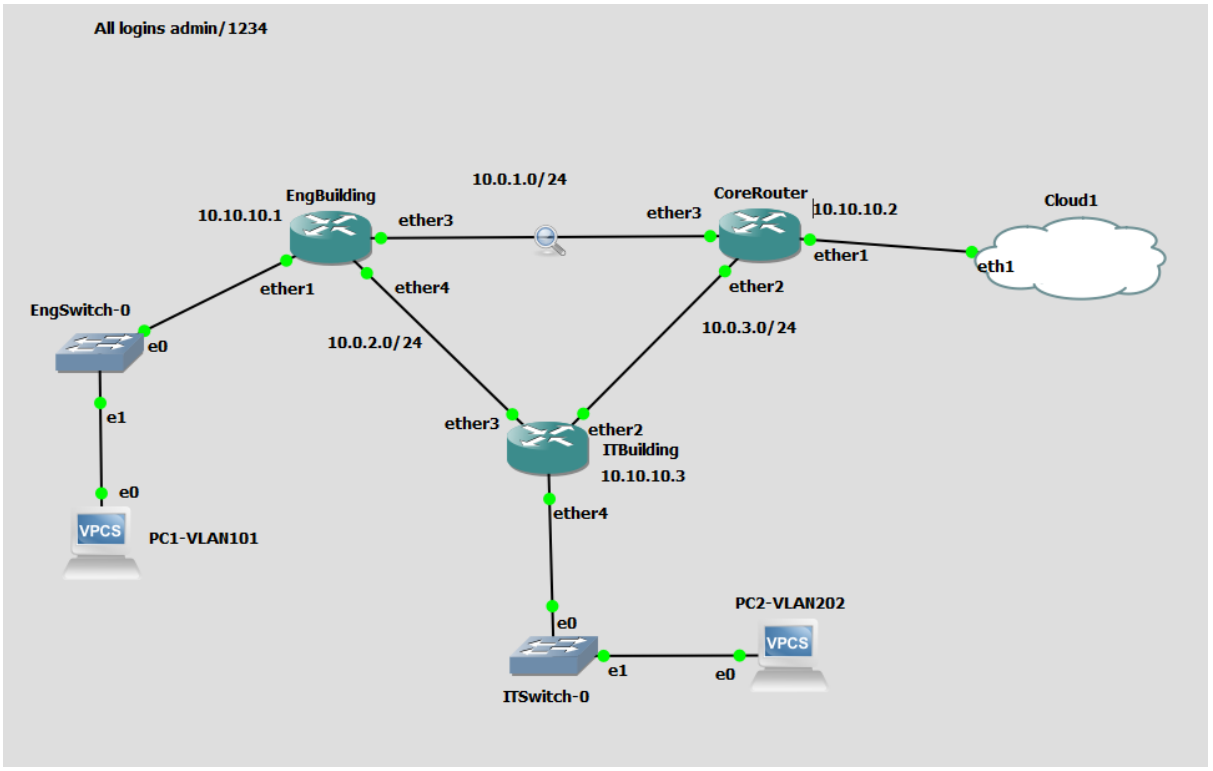

3 - Verify pinging over direct connection

```
[admin@CoreRouter] > ping 10.0.1.1
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 10.0.1.1                                   56  64 1ms
    1 10.0.1.1                                   56  64 1ms
    2 10.0.1.1                                   56  64 1ms
    3 10.0.1.1                                   56  64 0ms
    4 10.0.1.1                                   56  64 0ms
    5 10.0.1.1                                   56  64 0ms
    6 10.0.1.1                                   56  64 0ms
    7 10.0.1.1                                   56  64 0ms
    8 10.0.1.1                                   56  64 1ms
    9 10.0.1.1                                   56  64 1ms
    sent=10 received=10 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=1ms

[admin@CoreRouter] > ping 10.0.2.1
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 10.0.2.1                                   56  64 0ms
    1 10.0.2.1                                   56  64 0ms
    2 10.0.2.1                                   56  64 1ms
    3 10.0.2.1                                   56  64 0ms
    4 10.0.2.1                                   56  64 0ms
    5 10.0.2.1                                   56  64 0ms
    sent=6 received=6 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=1ms

[admin@CoreRouter] > ping 10.0.3.1
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 10.0.3.1                                   56  64 1ms
    1 10.0.3.1                                   56  64 0ms
    2 10.0.3.1                                   56  64 0ms
    3 10.0.3.1                                   56  64 1ms
    4 10.0.3.1                                   56  64 1ms
    5 10.0.3.1                                   56  64 0ms
    6 10.0.3.1                                   56  64 0ms
    sent=7 received=7 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=1ms

[admin@CoreRouter] > ping 10.0.4.1
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 10.0.4.1                                                timeout
    1 10.0.4.1                                                timeout
    2 10.0.4.1                                                timeout
    3 10.0.4.1                                                timeout
    sent=4 received=0 packet-loss=100%
```

8 - Verify that each router can then ping the Loopback address on each other and that the two PCs can ping each other.

```
[admin@CoreRouter] > ping 10.10.10.2
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 10.10.10.2                                 56  64 0ms
    1 10.10.10.2                                 56  64 0ms
    2 10.10.10.2                                 56  64 0ms
    sent=3 received=3 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms

[admin@CoreRouter] > ping 10.10.10.1
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 10.10.10.1                                 56  64 0ms
    1 10.10.10.1                                 56  64 0ms
    2 10.10.10.1                                 56  64 0ms
    sent=3 received=3 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms

[admin@CoreRouter] > ping 10.10.10.3
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 10.10.10.3                                 56  64 1ms
    1 10.10.10.3                                 56  64 0ms
    2 10.10.10.3                                 56  64 0ms
    sent=3 received=3 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=1ms
```

```
PC1-VLAN101> ping 192.168.200.254 -c 4

84 bytes from 192.168.200.254 icmp_seq=1 ttl=62 time=2.233 ms
84 bytes from 192.168.200.254 icmp_seq=2 ttl=62 time=1.839 ms
84 bytes from 192.168.200.254 icmp_seq=3 ttl=62 time=1.322 ms
84 bytes from 192.168.200.254 icmp_seq=4 ttl=62 time=1.550 ms
```

11 - Verify that the internet is reachable from all devices and explain the meaning of each entry in the routing table of the CoreRouter.

```
PC1-VLAN101> ping 10.226.255.1

84 bytes from 10.226.255.1 icmp_seq=1 ttl=126 time=4.156 ms
84 bytes from 10.226.255.1 icmp_seq=2 ttl=126 time=4.705 ms
84 bytes from 10.226.255.1 icmp_seq=3 ttl=126 time=4.800 ms
84 bytes from 10.226.255.1 icmp_seq=4 ttl=126 time=4.144 ms
84 bytes from 10.226.255.1 icmp_seq=5 ttl=126 time=4.161 ms
```

Core Router table

```
[admin@CoreRouter] > /ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
 #      DST-ADDRESS        PREF-SRC        GATEWAY            DISTANCE
 0 ADS  0.0.0.0/0                          192.168.127.2             1
 1 ADC  10.0.1.0/24        10.0.1.2        ether3                    0
 2 ADo  10.0.2.0/24                        10.0.1.1                110
                                           10.0.3.1
 3 ADC  10.0.3.0/24        10.0.3.2        ether2                    0
 4 ADo  10.10.10.1/32                      10.0.1.1                110
 5 ADC  10.10.10.2/32      10.10.10.2      Loopback                  0
 6 ADo  10.10.10.3/32                      10.0.3.1                110
 7 ADo  192.168.100.0/24                   10.0.1.1                110
 8 ADC  192.168.127.0/24   192.168.127.132 ether1                    0
 9 ADo  192.168.200.0/24                   10.0.3.1                110
```

Route 0: Default Route
Any traffic that doesn't match the entries in the routing table will be sent on to the next hop (the gateway declared here).

Route 1:
The direct connection to the router attached at ether3, with preferred source 10.0.1.2

Route 2:
The OSPF External-2 connection to the network 10.0.2.0/24, with two gateways, 10.0.1.1 and 10.0.3.1

Route 3:
Another direct connection, similar to route 1

Routes 4, 6, 7, 9:
More OSPF External connections to specific ip addresses.

Route 5:
The loopback interface of this router, with gateway 10.10.10.2

Route 8:
The route connected to the internet, through cloud1 on ether1.

12 - Explain what would happen if each router was not set up to redistribute connected networks, this was done in Step 7.

If the routers weren't set up to redistribute connected networks, then the table wouldn't include information about the directly connected networks. This would lead to

- No OSPF routes for connected networks
- Routing being limited to explicit configurations
- The loss of dynamic adaptability.

13 - Do a trace (using ICMP) from PC1-VLAN101 to PC2-VLAN202 and explain the route that is taken.

```
PC1-VLAN101> trace 192.168.200.254 -P 1
trace to 192.168.200.254, 8 hops max (ICMP), press Ctrl+C to stop
 1   192.168.100.1   0.740 ms  0.771 ms  0.585 ms
 2   10.0.2.2   2.107 ms  1.390 ms  1.839 ms
 3   192.168.200.254   2.632 ms  0.916 ms  0.878 ms
```

1. Hop to the EngBuilding router, which appears to this pc with the ip address 192.168.100.1, which is what is associated with that specific ethernet port.
2. The first router forwards the packet to the next router, visible to it as 10.0.2.2 via direct connection
3. This router is directly connected to the destination pc, which is the final hop.

14 - Run a long ping (for 30 seconds) from the PC1-VLAN101 to PC2-VLAN202 and while this is running suspend the link (right click on the link to see this option) from the EngBuilding router to the ITBuilding router.

```
PC1-VLAN101> ping 192.168.200.254 -c 20

84 bytes from 192.168.200.254 icmp_seq=1 ttl=62 time=2.092 ms
84 bytes from 192.168.200.254 icmp_seq=2 ttl=62 time=1.425 ms
84 bytes from 192.168.200.254 icmp_seq=3 ttl=62 time=1.630 ms
84 bytes from 192.168.200.254 icmp_seq=4 ttl=62 time=2.260 ms
*192.168.100.1 icmp_seq=5 ttl=64 time=0.918 ms (ICMP type:3, code:0, Destination network unreachable
)
*192.168.100.1 icmp_seq=6 ttl=64 time=0.623 ms (ICMP type:3, code:0, Destination network unreachable
)
84 bytes from 192.168.200.254 icmp_seq=7 ttl=61 time=3.227 ms
84 bytes from 192.168.200.254 icmp_seq=8 ttl=61 time=2.397 ms
84 bytes from 192.168.200.254 icmp_seq=9 ttl=61 time=2.848 ms
84 bytes from 192.168.200.254 icmp_seq=10 ttl=61 time=2.203 ms
84 bytes from 192.168.200.254 icmp_seq=11 ttl=61 time=2.312 ms
84 bytes from 192.168.200.254 icmp_seq=12 ttl=61 time=2.142 ms
84 bytes from 192.168.200.254 icmp_seq=13 ttl=61 time=2.839 ms
84 bytes from 192.168.200.254 icmp_seq=14 ttl=61 time=2.073 ms
84 bytes from 192.168.200.254 icmp_seq=15 ttl=61 time=2.096 ms
84 bytes from 192.168.200.254 icmp_seq=16 ttl=61 time=2.080 ms
84 bytes from 192.168.200.254 icmp_seq=17 ttl=61 time=2.066 ms
84 bytes from 192.168.200.254 icmp_seq=18 ttl=61 time=2.657 ms
84 bytes from 192.168.200.254 icmp_seq=19 ttl=61 time=2.129 ms
84 bytes from 192.168.200.254 icmp_seq=20 ttl=61 time=2.042 ms
```

15 - Are any pings dropped after the link is suspended? How long does it take for the ping to work again? Redo the trace, done in Step 13, and explain the results.

The fourth and fifth pings were dropped, but the route was reconfigured within two pings. Notable here is the increase in journey time, from 1.5~2.0 ms to 2~3ms, as the route passes through a whole extra router.

```
PC1-VLAN101> trace 192.168.200.254 -P 1
trace to 192.168.200.254, 8 hops max (ICMP), press Ctrl+C to stop
 1   192.168.100.1   0.749 ms  0.347 ms  0.584 ms
 2   10.0.1.2   2.999 ms  1.329 ms  1.873 ms
 3   10.0.3.1   2.926 ms  1.075 ms  0.900 ms
 4   192.168.200.254   4.832 ms  2.276 ms  1.184 ms
```

Different here is that the route goes through the core router, visible as 10.0.1.2, and from there to the ITBuilding router. However, the ITBuilding router has a different address visible to the core router as it does the EngBuilding router, so it appears as 10.0.3.1 instead of 10.0.2.2.

18 - Stop the packet capture and apply a display filter in Wireshark to only display OSPF packets. Explain the contents of any Link State Announcement (LSA) packets captured

Full packet capture in zip file

Going to look at two packets in particular:

71	31.083672	10.0.1.1	224.0.0.5 OSPF	110	LS Update
75	32.088162	10.0.1.2	224.0.0.5 OSPF	78	LS Acknowledge

LS Update

```
LSA-type 1 (Router-LSA), len 48
    .000 0000 0000 0001 = LS Age (seconds): 1
    0... .... .... .... = Do Not Age Flag: 0
    Options: 0x02, (E) External Routing
        0... .... = DN: Not set
        .0.. .... = O: Not set
        ..0. .... = (DC) Demand Circuits: Not supported
        ...0 .... = (L) LLS Data block: Not Present
        .... 0... = (N) NSSA: Not supported
        .... .0.. = (MC) Multicast: Not capable
        .... ..1. = (E) External Routing: Capable
        .... ...0 = (MT) Multi-Topology Routing: No
    LS Type: Router-LSA (1)
    Link State ID: 10.10.10.1
    Advertising Router: 10.10.10.1
    Sequence Number: 0x80000006
    Checksum: 0x05c0
    Length: 48
    Flags: 0x02, (E) AS boundary router
        0... .... = (H) flag: No
        ...0 .... = (N) flag: No
        .... 0... = (W) Wild-card multicast receiver: No
        .... .0.. = (V) Virtual link endpoint: No
        .... ..1. = (E) AS boundary router: Yes
        .... ...0 = (B) Area border router: No
    Number of Links: 2
    Type: Stub     ID: 10.0.2.0        Data: 255.255.255.0   Metric: 10
        Link ID: 10.0.2.0 - IP network/subnet number
        Link Data: 255.255.255.0
        Link Type: 3 - Connection to a stub network
        Number of Metrics: 0 - TOS
        0 Metric: 10
    Type: Transit  ID: 10.0.1.2        Data: 10.0.1.1        Metric: 10
        Link ID: 10.0.1.2 - IP address of Designated Router
        Link Data: 10.0.1.1
        Link Type: 2 - Connection to a transit network
        Number of Metrics: 0 - TOS
        0 Metric: 10
```

The LS Update Packet is of LSA-type 1, which means it's a Router LSA

It is two seconds old, and states that the router providing it (10.10.10.1, which is the EngBuilding router) is capable of external routing. The router advertising it is the source for it.

The other section of note is the two links connected, one being a stub (type 3) and the other being a transit network (type 2). All relevant details like the metric cost and link id are also contained.

LS Acknowledge

```
LSA-type 1 (Router-LSA), len 48
    .000 0000 0000 0001 = LS Age (seconds): 1
    0... .... .... .... = Do Not Age Flag: 0
    Options: 0x02, (E) External Routing
        0... .... = DN: Not set
        .0.. .... = O: Not set
        ..0. .... = (DC) Demand Circuits: Not supported
        ...0 .... = (L) LLS Data block: Not Present
        .... 0... = (N) NSSA: Not supported
        .... .0.. = (MC) Multicast: Not capable
        .... ..1. = (E) External Routing: Capable
        .... ...0 = (MT) Multi-Topology Routing: No
    LS Type: Router-LSA (1)
    Link State ID: 10.10.10.1
    Advertising Router: 10.10.10.1
    Sequence Number: 0x80000006
    Checksum: 0x05c0
    Length: 48
```

The headers for this packet are essentially the same as the Update packet, providing all of the important identifying information for the EngBuilding router, but contains none of the associated data carried by the previous packet. This is because the router has found no necessary information to update - the routes are all correct as far as it can tell, and it is just acknowledging all other encountered packets.