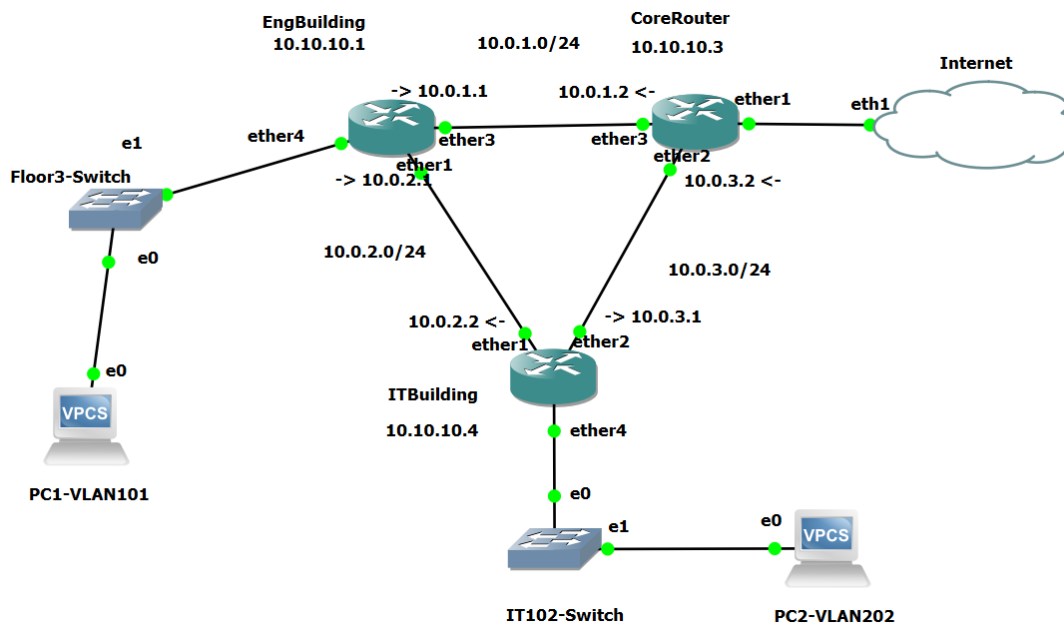


Assignment 2 - Build and Test OSPF Routed Network

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Network setup



Configurations

Core Router

```
/interface bridge
add name=Loopback
/interface ethernet
set [ find default-name=ether1 ] disable-running-check=no
set [ find default-name=ether2 ] disable-running-check=no
set [ find default-name=ether3 ] disable-running-check=no
set [ find default-name=ether4 ] disable-running-check=no
/interface wireless security-profiles
set [ find default=yes ] supplicant-identity=MikroTik
/routing ospf instance
set [ find default=yes ] distribute-default=if-installed-as-type-1
redistribute-connected=as-type-1 router-id=10.10.10.3
/ip address
add address=10.10.10.3 interface=Loopback network=10.10.10.3
add address=10.0.3.2/24 interface=ether2 network=10.0.3.0
add address=10.0.1.2/24 interface=ether3 network=10.0.1.0
/ip dhcp-client
add disabled=no interface=ether1
/ip firewall nat
add action=masquerade chain=srcnat out-interface=ether1
add action=masquerade chain=srcnat out-interface=ether1
/routing ospf interface
add dead-interval=5s hello-interval=1s interface=ether2
add dead-interval=5s hello-interval=1s interface=ether3
/routing ospf network
add area=backbone network=10.0.3.0/24
add area=backbone network=10.0.1.0/24
/system identity
set name=CoreRouter
```

EngBuilding

```
/interface bridge
add name=Loopback
/interface ethernet
set [ find default-name=ether1 ] disable-running-check=no
set [ find default-name=ether2 ] disable-running-check=no
set [ find default-name=ether3 ] disable-running-check=no
set [ find default-name=ether4 ] disable-running-check=no
/interface vlan
add interface=ether4 name=VLAN101 vlan-id=101
/interface wireless security-profiles
set [ find default=yes ] supplicant-identity=MikroTik
/ip pool
add name=dhcp_pool0 ranges=192.168.100.2-192.168.100.254
/ip dhcp-server
add address-pool=dhcp_pool0 disabled=no interface=VLAN101 name=dhcp1
/routing ospf instance
set [ find default=yes ] distribute-default=if-installed-as-type-1 \
    redistribute-connected=as-type-1 router-id=10.10.10.1
/ip address
add address=192.168.100.1/24 interface=VLAN101 network=192.168.100.0
add address=10.10.10.1 interface=Loopback network=10.10.10.1
add address=10.0.2.1/24 interface=ether1 network=10.0.2.0
add address=10.0.1.1/24 interface=ether3 network=10.0.1.0
/ip dhcp-server network
add address=192.168.100.0/24 dns-server=8.8.8.8 gateway=192.168.100.1
/routing ospf interface
add dead-interval=5s hello-interval=1s interface=ether1
add dead-interval=5s hello-interval=1s interface=ether3
/routing ospf network
add area=backbone network=10.0.1.0/24
add area=backbone network=10.0.2.0/24
/system identity
set name=EngBuilding
[admin@EngBuilding] > █
```

ITBuilding

```
/interface bridge
add name=Loopback
/interface ethernet
set [ find default-name=ether1 ] disable-running-check=no
set [ find default-name=ether2 ] disable-running-check=no
set [ find default-name=ether3 ] disable-running-check=no
set [ find default-name=ether4 ] disable-running-check=no
/interface vlan
add interface=ether4 name=VLAN202 vlan-id=202
/interface wireless security-profiles
set [ find default=yes ] supplicant-identity=MikroTik
/ip pool
add name=dhcp_pool0 ranges=192.168.200.2-192.168.200.254
/ip dhcp-server
add address-pool=dhcp_pool0 disabled=no interface=VLAN202 name=dhcp1
/routing ospf instance
set [ find default=yes ] distribute-default=if-installed-as-type-1 \
    redistribute-connected=as-type-1 router-id=10.10.10.4
/ip address
add address=192.168.200.1/24 interface=VLAN202 network=192.168.200.0
add address=10.10.10.4 interface=Loopback network=10.10.10.4
add address=10.0.3.1/24 interface=ether2 network=10.0.3.0
add address=10.0.2.2/24 interface=ether1 network=10.0.2.0
/ip dhcp-server network
add address=192.168.200.0/24 dns-server=8.8.8.8 gateway=192.168.200.1
/routing ospf interface
add dead-interval=5s hello-interval=1s interface=ether1
add dead-interval=5s hello-interval=1s interface=ether2
/routing ospf network
add area=backbone network=10.0.2.0/24
add area=backbone network=10.0.3.0/24
/system identity
set name=ITBuilding
[admin@ITBuilding] > █
```

3: Verify that the routers can ping each other over the direct links between each router.

Core Router

```
[admin@CoreRouter] > ping 10.0.3.2
SEQ HOST                                SIZE TTL TIME  STATUS
  0 10.0.3.2                            56  64 0ms
  1 10.0.3.2                            56  64 0ms
  2 10.0.3.2                            56  64 0ms
sent=3 received=3 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms

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

EngBuilding

```
[admin@EngBuilding] > ping 10.0.2.2
SEQ HOST                                SIZE TTL TIME  STATUS
  0 10.0.2.2                            56  64 0ms
  1 10.0.2.2                            56  64 0ms
  2 10.0.2.2                            56  64 0ms
sent=3 received=3 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms
```

```
admin@EngBuilding] > ping 10.0.1.2
SEQ HOST                                SIZE TTL TIME  STATUS
  0 10.0.1.2                            56  64 1ms
  1 10.0.1.2                            56  64 0ms
  2 10.0.1.2                            56  64 0ms
  3 10.0.1.2                            56  64 0ms
sent=4 received=4 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=1ms
```

ITBuilding

```
[admin@ITBuilding] > 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 0ms
sent=3 received=3 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms

[admin@ITBuilding] > ping 10.0.3.2
SEQ HOST                                SIZE TTL TIME  STATUS
  0 10.0.3.2                            56  64 0ms
  1 10.0.3.2                            56  64 0ms
  2 10.0.3.2                            56  64 0ms
sent=3 received=3 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms
```


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

Core router

```
[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
sent=2 received=2 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms

[admin@CoreRouter] > ping 10.10.10.4
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.10.10.4                            56  64 0ms
1 10.10.10.4                            56  64 0ms
sent=2 received=2 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms
```

ITBuilding

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

[admin@ITBuilding] > 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
sent=2 received=2 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms
```

EngBuilding

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

[admin@EngBuilding] > ping 10.10.10.4
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.10.10.4                            56  64 1ms
1 10.10.10.4                            56  64 1ms
sent=2 received=2 packet-loss=0% min-rtt=1ms avg-rtt=1ms max-rtt=1ms
```

PC's pinging one another.

```
PC1-VLAN101> dhcp
DORA IP 192.168.100.253/24 GW 192.168.100.1

PC1-VLAN101> ping 192.168.200.253

84 bytes from 192.168.200.253 icmp_seq=1 ttl=62 time=1.172 ms
84 bytes from 192.168.200.253 icmp_seq=2 ttl=62 time=0.764 ms
84 bytes from 192.168.200.253 icmp_seq=3 ttl=62 time=0.851 ms
84 bytes from 192.168.200.253 icmp_seq=4 ttl=62 time=0.867 ms
```

```
PC2-VLAN202> dhcp
DORA IP 192.168.200.253/24 GW 192.168.200.1

PC2-VLAN202> ping 192.168.100.253

84 bytes from 192.168.100.253 icmp_seq=1 ttl=62 time=0.856 ms
84 bytes from 192.168.100.253 icmp_seq=2 ttl=62 time=0.741 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.

```
[admin@CoreRouter] > ping 10.226.255.1
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.226.255.1                          56 128 2ms
1 10.226.255.1                          56 128 2ms
sent=2 received=2 packet-loss=0% min-rtt=2ms avg-rtt=2ms max-rtt=2ms

[admin@EngBuilding] > ping 10.226.255.1
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.226.255.1                          56 127 3ms
1 10.226.255.1                          56 127 2ms
sent=2 received=2 packet-loss=0% min-rtt=2ms avg-rtt=2ms max-rtt=3ms

[admin@ITBuilding] > ping 10.226.255.1
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.226.255.1                          56 127 2ms
1 10.226.255.1                          56 127 1ms
sent=2 received=2 packet-loss=0% min-rtt=1ms avg-rtt=1ms max-rtt=2ms

PC1-VLAN101> ping 10.226.255.1

84 bytes from 10.226.255.1 icmp_seq=1 ttl=126 time=3.877 ms
84 bytes from 10.226.255.1 icmp_seq=2 ttl=126 time=3.674 ms
^C
-
PC2-VLAN202> ping 10.226.255.1

84 bytes from 10.226.255.1 icmp_seq=1 ttl=126 time=2.798 ms
84 bytes from 10.226.255.1 icmp_seq=2 ttl=126 time=3.159 ms
^C
```

Note – on university network so using 10.226.255.1 instead of google / wider internet

Explaining the CoreRouter routing table

```
/routing ospf instance
set [ find default=yes ] distribute-default=if-installed-as-type-1 \
redistribute-connected=as-type-1 router-id=10.10.10.3
```

This configures the distribution of the default route. It sets the default route to be distributed as an OSPF Type 1 external route, also configuring the redistribution of connected routes into OSPF as Type 1 external routes. This means that any directly connected networks will be advertised into the OSPF domain with a Type 1 external metric. (In OSPF, Type 1 external routes are typically used for routes redistributed from another routing protocol, and they have a higher administrative distance compared to Type 2 external routes.)

It also sets the router ID for the OSPF instance to the IP address 10.10.10.3 – this is used as an identifier for the OSPF router within the OSPF domain.

```
/routing ospf interface
add dead-interval=5s hello-interval=1s interface=ether2
add dead-interval=5s hello-interval=1s interface=ether3
```

In the OSPF interface, we add both ether2 & ether3 to the OSPF config, with the settings that the dead interval is set to 5 seconds, and the hello interval to 1 second.

The dead interval is the time a router must go without receiving a hello packet from a neighbor before considering the neighbor down/dead.

The hello interval is how often a OSPF router is to send hello packets to discover and to maintain neighbor relationships with other OSPF routers.

```
/routing ospf network
add area=backbone network=10.0.3.0/24
add area=backbone network=10.0.1.0/24
```

These are to add the 10.0.3.0/24 and the 10.0.1.0/24 network to the OSPF configuration and associates it with the backbone area – the backbone area being area 0. It plays the role of the central node in the OSPF network, and the link information of other areas is transmitted through area 0, where all other areas are connected to it.

All OSPF routers must be members of the backbone area.

```
/routing ospf instance
set [ find default=yes ] distribute-default=if-installed-as-type-1 \
    redistribute-connected=as-type-1 router-id=10.10.10.3
/routing ospf interface
add dead-interval=5s hello-interval=1s interface=ether2
add dead-interval=5s hello-interval=1s interface=ether3
/routing ospf network
add area=backbone network=10.0.3.0/24
add area=backbone network=10.0.1.0/24
```

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

Without distributing connected networks, routers won't advertise the IP subnets directly connected to them into the OSPF domain, meaning that these networks would not be part of the OSPF routing tables and wouldn't be reachable via OSPF routing. Eg. Not sharing the Clifden/Loughrea subnets.

This also is the same for local area networks/virtual local area networks, but isolating them entirely, e.g., not sharing the engineering building / IT Building VLANs.

Routers within the OSPF domain would only have information about OSPF-learned routes and wouldn't possess any visibility into any networks that are directly connected to other routers, potentially limiting reachability of devices/networks directly connected to one of the routers in this OSPF domain.

Because of this, it would lead to suboptimal routing / inefficient network utilisation due to lack of knowledge on connected networks for routing decisions.

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    0.383 ms  0.165 ms  0.376 ms
 2  10.0.2.2        0.577 ms  0.414 ms  0.481 ms
 3  192.168.200.254  0.608 ms  0.718 ms  0.892 ms
```

This is the VPC in VLAN101 in EngBuilding. It firstly goes past its switch to its VLAN gateway at the EngBuilding router (192.168.100.1). From there it goes to the ITBuilding router's gateway which is at 10.0.2.2 for the EngBuilding - ITBuilding direct link. After that it traverses the ITBuilding switch and reaches the VLAN202 VPC at 192.168.200.254.

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 30
84 bytes from 192.168.200.254 icmp_seq=1 ttl=62 time=0.799 ms
84 bytes from 192.168.200.254 icmp_seq=2 ttl=62 time=0.992 ms
84 bytes from 192.168.200.254 icmp_seq=3 ttl=62 time=0.754 ms
84 bytes from 192.168.200.254 icmp_seq=4 ttl=62 time=0.752 ms
84 bytes from 192.168.200.254 icmp_seq=5 ttl=62 time=1.480 ms
192.168.200.254 icmp_seq=6 timeout
84 bytes from 192.168.200.254 icmp_seq=7 ttl=61 time=1.514 ms
84 bytes from 192.168.200.254 icmp_seq=8 ttl=61 time=1.747 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.

What happens is a ping is dropped and the routers realise they need to search for an alternate route if one exists. In the icmp_sequence 7 it has discovered an alternate route, where it's only been dropped for one ping length.

With a trace route it takes the following path:

It again firstly goes past its switch to its VLAN gateway at the EngBuilding router (192.168.100.1). Now it deviates and goes to the CoreRouter's gateway for the EngBuilding – CoreRouter direct link at 10.0.1.2.

From there it goes to the ITBuilding router gateway for the CoreRouter – ITBuilding link which is at 10.0.3.1. Finally, after that it traverses past the ITBuilding switch and reaches the VLAN202 VPC at 192.168.200.254.

```
PC1-VLAN101> trace 192.168.200.254 -P 1
trace to 192.168.200.254, 8 hops max (ICMP), press C
 1  192.168.100.1   0.383 ms  0.939 ms  0.198 ms
 2  10.0.1.2       1.599 ms  0.570 ms  0.371 ms
 3  10.0.3.1       1.694 ms  0.802 ms  1.075 ms
 4  192.168.200.254 0.949 ms  1.301 ms  1.933 ms
```

16-18: 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.

In this capture, we firstly got a LS Update from both EngBuilding and ITBuilding updating / probing to fully synchronize between the two routers. They both acknowledge each other's announcement.

As detailed [here](#), the router or i5/OS whose router identifier is numerically higher, assumes the primary role and the other assumes the secondary role. The primary router sends its database descriptions, one at a time. The secondary router acknowledges each one and includes in the acknowledgement its own database descriptions.

As we see here, the 10.0.1.2 router takes the primary role and sends its own database records, where we see 10.0.1.1 acknowledge these updates.

At this point they are now fully synchronized on this link and can resume routing along it. Throughout the whole time they are keeping in contact with each other on their Hello Packets.

10.0.1.2	224.0.0.5	OSPF	82 Hello Packet
10.0.1.2	224.0.0.5	OSPF	110 LS Update
10.0.1.1	224.0.0.5	OSPF	110 LS Update
10.0.1.1	224.0.0.5	OSPF	82 Hello Packet
10.0.1.2	224.0.0.5	OSPF	82 Hello Packet
10.0.1.2	224.0.0.5	OSPF	78 LS Acknowledge
10.0.1.1	224.0.0.5	OSPF	78 LS Acknowledge
10.0.1.1	224.0.0.5	OSPF	82 Hello Packet
10.0.1.2	224.0.0.5	OSPF	82 Hello Packet
10.0.1.1	224.0.0.5	OSPF	82 Hello Packet
10.0.1.2	224.0.0.5	OSPF	82 Hello Packet
10.0.1.1	224.0.0.5	OSPF	82 Hello Packet
10.0.1.2	224.0.0.5	OSPF	82 Hello Packet
10.0.1.2	224.0.0.5	OSPF	142 LS Update
10.0.1.2	224.0.0.5	OSPF	110 LS Update
10.0.1.1	224.0.0.5	OSPF	110 LS Update
10.0.1.1	224.0.0.5	OSPF	82 Hello Packet
10.0.1.2	224.0.0.5	OSPF	82 Hello Packet
10.0.1.1	224.0.0.5	OSPF	118 LS Acknowledge
10.0.1.1	224.0.0.5	OSPF	82 Hello Packet