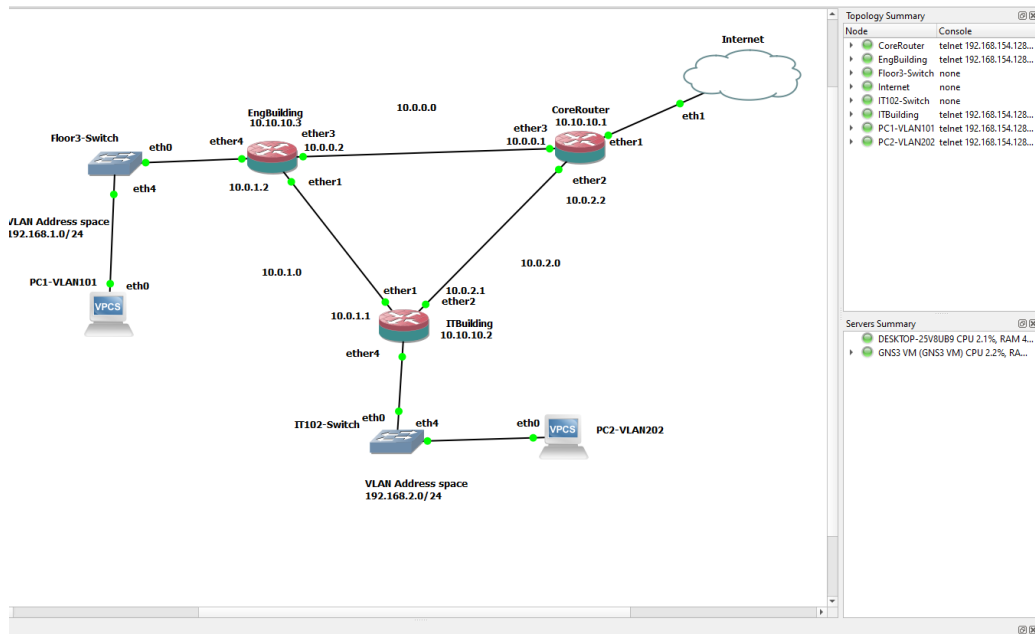


Assignment 2 - CT3531 Networks & Data Communications II

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1 GNS3 Config



2 Router Configs

```
[admin@CoreRouter] > export
# nov/24/2021 22:41:16 by RouterOS 6.48.5
# software id =
#
#
/interface bridge
add name=Loopback
/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=10.10.10.1
/ip address
add address=10.0.2.2/24 interface=ether2 network=10.0.2.0
add address=10.10.10.1 interface=Loopback network=10.10.10.1
add address=10.0.0.1/24 interface=ether3 network=10.0.0.0
/ip dhcp-client
add disabled=no interface=ether1
/ip firewall nat
add action=masquerade chain=srcnat out-interface=ether1
/routing ospf interface
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=10.0.0.0/24
/system identity
set name=CoreRouter
[admin@CoreRouter] > /routing ospf interface add dead-interval=5s hello-interval=1s interface=ether3
[admin@CoreRouter] > export
# nov/24/2021 22:59:54 by RouterOS 6.48.5
# software id =
#
#
/interface bridge
add name=Loopback
/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=10.10.10.1
/ip address
add address=10.0.2.2/24 interface=ether2 network=10.0.2.0
add address=10.10.10.1 interface=Loopback network=10.10.10.1
add address=10.0.0.1/24 interface=ether3 network=10.0.0.0
/ip dhcp-client
add disabled=no interface=ether1
/ip firewall nat
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=10.0.2.0/24
add area=backbone network=10.0.0.0/24
/system identity
set name=CoreRouter
[admin@CoreRouter] >
```

Figure 1: Core Router Config

```
[admin@EngBuilding] > export
# nov/24/2021 22:59:32 by RouterOS 6.48.5
# software id =
#
#
/interface bridge
add name=Loopback
/interface vlan
add interface=ether4 name=Eng-vlan vlan-id=101
/interface wireless security-profiles
set [ find default=yes ] supplicant-identity=MikroTik
/ip pool
add name=dhcp-pool1 ranges=192.168.1.2-192.168.1.254
/ip dhcp-server
add address-pool=dhcp-pool1 disabled=no interface=Eng-vlan name=dhcp1
/routing ospf instance
set [ find default=yes ] 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=10.0.0.2/24 interface=ether3 network=10.0.0.0
add address=10.0.1.2/24 interface=ether1 network=10.0.1.0
add address=192.168.1.1/24 interface=Eng-vlan network=192.168.1.0
/ip dhcp-server network
add address=192.168.1.0/24 dns-server=8.8.8.8 gateway=192.168.1.1
/routing ospf interface
add dead-interval=5s hello-interval=1s interface=ether3
add dead-interval=5s hello-interval=1s interface=ether1
/routing ospf network
add area=backbone network=10.0.0.0/24
add area=backbone network=10.0.1.0/24
/system identity
set name=EngBuilding
[admin@EngBuilding] >
```

Figure 2: Engineering Router Config

```
[admin@ITBuilding] > export
# nov/24/2021 22:59:43 by RouterOS 6.48.5
# software id =
#
#
/interface bridge
add name=Loopback
/interface vlan
add interface=ether4 name=IT-vlan vlan-id=202
/interface wireless security-profiles
set [ find default=yes ] supplicant-identity=MikroTik
/ip pool
add name=dhcp-pool0 ranges=192.168.2.2-192.168.2.254
/ip dhcp-server
add address-pool=dhcp-pool0 disabled=no interface=IT-vlan name=dhcp2
/routing ospf instance
set [ find default=yes ] redistribute-connected=as-type-1 router-id=10.10.10.2
/ip address
add address=192.168.2.1/24 interface=IT-vlan network=192.168.2.0
add address=10.0.2.1/24 interface=ether2 network=10.0.2.0
add address=10.10.10.2 interface=Loopback network=10.10.10.2
add address=10.0.1.1/24 interface=ether1 network=10.0.1.0
/ip dhcp-server network
add address=192.168.2.0/24 dns-server=8.8.8.8 gateway=192.168.2.1
/routing ospf interface
add dead-interval=5s hello-interval=1s interface=ether2
add dead-interval=5s hello-interval=1s interface=ether1
/routing ospf network
add area=backbone network=10.0.2.0/24
add area=backbone network=10.0.1.0/24
/system identity
set name=ITBuilding
[admin@ITBuilding] >
```

Figure 3: IT Router Config

3 Loopback Ping Verification

```
[admin@CoreRouter] > ping 10.10.10.3
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.10.10.3                            56  64 4ms
1 10.10.10.3                            56  64 2ms
2 10.10.10.3                            56  64 1ms
sent=3 received=3 packet-loss=0% min-rtt=1ms avg-rtt=2ms max-rtt=4ms

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

[admin@CoreRouter] > █
```

Figure 4: Core Loopback Pings

```
[admin@ITBuilding] > ping 10.10.10.1
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.10.10.1                            56  64 28ms
1 10.10.10.1                            56  64 2ms
sent=2 received=2 packet-loss=0% min-rtt=2ms avg-rtt=15ms max-rtt=28ms

[admin@ITBuilding] > ping 10.10.10.3
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.10.10.3                            56  64 2ms
1 10.10.10.3                            56  64 1ms
2 10.10.10.3                            56  64 2ms
3 10.10.10.3                            56  64 5ms
4 10.10.10.3                            56  64 1ms
sent=5 received=5 packet-loss=0% min-rtt=1ms avg-rtt=2ms max-rtt=5ms

[admin@ITBuilding] > █
```

Figure 5: IT Loopback Pings

```
admin@EngBuilding] > ping 10.10.10.2
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.10.10.2                            56  64 10ms
1 10.10.10.2                            56  64 2ms
2 10.10.10.2                            56  64 2ms
sent=3 received=3 packet-loss=0% min-rtt=2ms avg-rtt=4ms max-rtt=10ms

admin@EngBuilding] > ping 10.10.10.1
SEQ HOST                                SIZE TTL TIME  STATUS
0 10.10.10.1                            56  64 2ms
1 10.10.10.1                            56  64 18ms
2 10.10.10.1                            56  64 1ms
sent=3 received=3 packet-loss=0% min-rtt=1ms avg-rtt=7ms max-rtt=18ms

admin@EngBuilding] > █
```

Figure 6: Engineering Loopback Pings

4 Routing Table Verification

```
admin@core> show ip route
AREA      TYPE      ID          ORIGINATOR  SEQUENCE-NUMBER  AGE
-----
backbone  router    10.10.10.1  10.10.10.1  0x00000000        175
backbone  router    10.10.10.2  10.10.10.2  0x00000005        1437
backbone  router    10.10.10.3  10.10.10.3  0x00000006        1433
backbone  network   10.0.0.2    10.10.10.3  0x00000001        1726
backbone  network   10.0.1.1    10.10.10.2  0x00000001        1437
backbone  network   10.0.2.1    10.10.10.2  0x00000002        749
external  as-external 0.0.0.0     10.10.10.1  0x00000002        751
external  as-external 10.10.10.1  10.10.10.1  0x00000002        751
external  as-external 10.10.10.2  10.10.10.2  0x00000002        886
external  as-external 10.10.10.3  10.10.10.3  0x00000002        631
external  as-external 192.168.1.0 10.10.10.3  0x00000001        1145
external  as-external 192.168.2.0 10.10.10.2  0x00000002        886
external  as-external 192.168.239.0 10.10.10.1  0x00000002        751

admin@core> show ip neighbor
instance default router address interface priority adjacency
0         default 10.10.10.3 10.10.10.3 interface0 1 0 10.10.10.3 0 adjacency33m57s
1         default 10.10.10.2 10.10.10.2 interface0 1 0 10.10.10.2 0 adjacency46m56s

admin@core>
```

Figure 7: Core Routing Table & Neighbor list

```
admin@it> show ip route
AREA      TYPE      ID          ORIGINATOR  SEQUENCE-NUMBER  AGE
-----
backbone  router    10.10.10.1  10.10.10.1  0x00000000        19
backbone  router    10.10.10.2  10.10.10.2  0x00000005        1476
backbone  router    10.10.10.3  10.10.10.3  0x00000006        1476
backbone  network   10.0.0.2    10.10.10.3  0x00000001        28
backbone  network   10.0.1.1    10.10.10.2  0x00000001        1476
backbone  network   10.0.2.1    10.10.10.2  0x00000002        792
external  as-external 0.0.0.0     10.10.10.1  0x00000002        795
external  as-external 10.10.10.1  10.10.10.1  0x00000002        795
external  as-external 10.10.10.2  10.10.10.2  0x00000002        849
external  as-external 10.10.10.3  10.10.10.3  0x00000002        694
external  as-external 192.168.1.0 10.10.10.3  0x00000001        1196
external  as-external 192.168.2.0 10.10.10.2  0x00000002        849
external  as-external 192.168.239.0 10.10.10.1  0x00000002        795

admin@it>
```

Figure 8: IT Routing Table & Neighbor list

```
admin@eng> show ip route
AREA      TYPE      ID          ORIGINATOR  SEQUENCE-NUMBER  AGE
-----
backbone  router    10.10.10.1  10.10.10.1  0x00000000        51
backbone  router    10.10.10.2  10.10.10.2  0x00000005        1514
backbone  router    10.10.10.3  10.10.10.3  0x00000006        1508
backbone  network   10.0.0.2    10.10.10.3  0x00000001        53
backbone  network   10.0.1.1    10.10.10.2  0x00000001        1514
backbone  network   10.0.2.1    10.10.10.2  0x00000002        825
external  as-external 0.0.0.0     10.10.10.1  0x00000002        828
external  as-external 10.10.10.1  10.10.10.1  0x00000002        828
external  as-external 10.10.10.2  10.10.10.2  0x00000002        882
external  as-external 10.10.10.3  10.10.10.3  0x00000002        726
external  as-external 192.168.1.0 10.10.10.3  0x00000001        1211
external  as-external 192.168.2.0 10.10.10.2  0x00000002        882
external  as-external 192.168.239.0 10.10.10.1  0x00000002        828

admin@eng>
```

Figure 9: Engineering Routing Table & Neighbor list

5 Internet connection verification

```
PC1-VLAN101> ping 8.8.8.8
84 bytes from 8.8.8.8 icmp_seq=1 ttl=126 time=34.464 ms
84 bytes from 8.8.8.8 icmp_seq=2 ttl=126 time=22.558 ms
84 bytes from 8.8.8.8 icmp_seq=3 ttl=126 time=24.992 ms
84 bytes from 8.8.8.8 icmp_seq=4 ttl=126 time=28.960 ms
^C
PC1-VLAN101>
```

Figure 10: PC1 Internet Ping

```
PC2-VLAN202> ping 8.8.8.8
84 bytes from 8.8.8.8 icmp_seq=1 ttl=126 time=31.958 ms
84 bytes from 8.8.8.8 icmp_seq=2 ttl=126 time=317.855 ms
84 bytes from 8.8.8.8 icmp_seq=3 ttl=126 time=30.723 ms
84 bytes from 8.8.8.8 icmp_seq=4 ttl=126 time=22.691 ms
84 bytes from 8.8.8.8 icmp_seq=5 ttl=126 time=24.663 ms
PC2-VLAN202> dhcp
```

Figure 11: PC2 Internet Ping

Proof the routers can reach the internet is trivial.

6 Step 12

If the routers were not configured correctly to perform OSPF neither the Engineering or IT routers would be able to connect to the internet as they would not know that there was a DHCP gateway on the core router. Furthermore, the computers on either the IT or Engineering network would be unable to communicate with eachother (or get a dynamically assigned ip address as they would be unable to reach the dns server (8.8.8.8)) The routers at IT and Engineering would no longer be able to communicate if the direct link was severed as they would not know of the other route.

7 Step 13

```
PC1-VLAN101> trace 192.168.2.254
trace to 192.168.2.254, 8 hops max, press Ctrl+C to stop
 1  192.168.1.1    2.826 ms  2.279 ms  0.388 ms
 2  10.0.1.1     3.980 ms  0.972 ms  0.685 ms
 3  *192.168.2.254  1.759 ms (ICMP type:3, code:3, Destination port unreachable)

PC1-VLAN101> █
```

1. 192.168.1.1 was the IP address of the Engineering Router
2. 10.0.1.1 is the IP address of IT Router on the direct line between it and the engineering router
3. 192.168.2.254 was the destination.

8 Step 15

```
84 bytes from 192.168.2.254 icmp_seq=21 ttl=62 time=1.433 ms
84 bytes from 192.168.2.254 icmp_seq=22 ttl=62 time=1.438 ms
84 bytes from 192.168.2.254 icmp_seq=23 ttl=62 time=2.301 ms
84 bytes from 192.168.2.254 icmp_seq=24 ttl=62 time=1.972 ms
84 bytes from 192.168.2.254 icmp_seq=25 ttl=62 time=1.499 ms
84 bytes from 192.168.2.254 icmp_seq=26 ttl=62 time=2.064 ms
192.168.2.254 icmp_seq=27 timeout
192.168.2.254 icmp_seq=28 timeout
192.168.2.254 icmp_seq=29 timeout
192.168.2.254 icmp_seq=30 timeout
84 bytes from 192.168.2.254 icmp_seq=31 ttl=61 time=8.343 ms
84 bytes from 192.168.2.254 icmp_seq=32 ttl=61 time=2.594 ms
84 bytes from 192.168.2.254 icmp_seq=33 ttl=61 time=3.420 ms
84 bytes from 192.168.2.254 icmp_seq=34 ttl=61 time=2.349 ms
84 bytes from 192.168.2.254 icmp_seq=35 ttl=61 time=2.585 ms
84 bytes from 192.168.2.254 icmp_seq=36 ttl=61 time=1.889 ms
84 bytes from 192.168.2.254 icmp_seq=37 ttl=61 time=2.444 ms
84 bytes from 192.168.2.254 icmp_seq=38 ttl=61 time=2.017 ms
84 bytes from 192.168.2.254 icmp_seq=39 ttl=61 time=2.310 ms
^C
PC1-VLAN101> trace 192.168.2.254
trace to 192.168.2.254, 8 hops max, press Ctrl+C to stop
 1  192.168.1.1  4.140 ms  0.592 ms  0.406 ms
 2  10.0.0.1    7.108 ms  0.992 ms  0.811 ms
 3  10.0.2.1    4.726 ms  1.788 ms  1.538 ms
 4  *192.168.2.254  2.371 ms (ICMP type:3, code:3, Destination port unreachable)
PC1-VLAN101> █
```

Ultimately four pings failed, which spanned about six seconds in duration. which was expected considering the dead-interval and hello interval. The new route denotes:

1. The Engineering router
2. Core Router
3. IT Router
4. The Destination PC

9 LSA's from reconnecting the routers directly again

```

▼ Open Shortest Path First
  > OSPF Header
  ▼ LS Update Packet
    Number of LSAs: 2
    ▼ 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
      LS Type: Router-LSA (1)
      Link State ID: 10.10.10.3
      Advertising Router: 10.10.10.3
      Sequence Number: 0x80000009
      Checksum: 0x5e54
      Length: 48
      > Flags: 0x02, (E) AS boundary router
      Number of Links: 2
      > Type: Transit ID: 10.0.1.2      Data: 10.0.1.2      Metric: 10
      > Type: Transit ID: 10.0.0.2      Data: 10.0.0.2      Metric: 10
    ▼ LSA-type 2 (Network-LSA), len 32
      .000 0000 0000 0001 = LS Age (seconds): 1
      0... .... = Do Not Age Flag: 0
      > Options: 0x02, (E) External Routing
      LS Type: Network-LSA (2)
      Link State ID: 10.0.1.2
      Advertising Router: 10.10.10.3
      Sequence Number: 0x80000001
      Checksum: 0x7179
      Length: 32
      Netmask: 255.255.255.0
      Attached Router: 10.10.10.3
      Attached Router: 10.10.10.2

```

Figure 12: First Link State Announcement

```

> Frame 57: 110 bytes on wire (880 bits), 110 bytes captured (880 bits) on interface -, id 0
> Ethernet II, Src: 0c:0c:d4:fe:00:02 (0c:0c:d4:fe:00:02), Dst: IPv4mcast_05 (01:00:5e:00:00:05)
> Internet Protocol Version 4, Src: 10.0.0.2, Dst: 224.0.0.5
▼ Open Shortest Path First
  ▼ OSPF Header
    Version: 2
    Message Type: LS Update (4)
    Packet Length: 76
    Source OSPF Router: 10.10.10.3
    Area ID: 0.0.0.0 (Backbone)
    Checksum: 0x7d0c [correct]
    Auth Type: Null (0)
    Auth Data (none): 0000000000000000
  ▼ LS Update Packet
    Number of LSAs: 1
    ▼ LSA-type 1 (Router-LSA), len 48
      .000 0000 0000 0010 = LS Age (seconds): 2
      0... .... = Do Not Age Flag: 0
      > Options: 0x02, (E) External Routing
      LS Type: Router-LSA (1)
      Link State ID: 10.10.10.2
      Advertising Router: 10.10.10.2
      Sequence Number: 0x80000008
      Checksum: 0x8e26
      Length: 48
      > Flags: 0x02, (E) AS boundary router
      Number of Links: 2
      > Type: Transit ID: 10.0.1.2      Data: 10.0.1.1      Metric: 10
      > Type: Transit ID: 10.0.2.1      Data: 10.0.2.1      Metric: 10

```

Figure 13: Second Link State Announcement

```

> Frame 60: 118 bytes on wire (944 bits), 118 bytes captured (944 bits) on interface -, id 0
> Ethernet II, Src: 0c:e3:6e:e5:00:02 (0c:e3:6e:e5:00:02), Dst: IPv4mcast_05 (01:00:5e:00:00:05)
> Internet Protocol Version 4, Src: 10.0.0.1, Dst: 224.0.0.5
▼ Open Shortest Path First
  > OSPF Header
  ▼ 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
    LS Type: Router-LSA (1)
    Link State ID: 10.10.10.3
    Advertising Router: 10.10.10.3
    Sequence Number: 0x80000009
    Checksum: 0x5e54
    Length: 48
  ▼ LSA-type 2 (Network-LSA), len 32
    .000 0000 0000 0001 = LS Age (seconds): 1
    0... .... .... .... = Do Not Age Flag: 0
    > Options: 0x02, (E) External Routing
    LS Type: Network-LSA (2)
    Link State ID: 10.0.1.2
    Advertising Router: 10.10.10.3
    Sequence Number: 0x80000001
    Checksum: 0x7179
    Length: 32
  ▼ LSA-type 1 (Router-LSA), len 48
    .000 0000 0000 0010 = LS Age (seconds): 2
    0... .... .... .... = Do Not Age Flag: 0
    > Options: 0x02, (E) External Routing
    LS Type: Router-LSA (1)
    Link State ID: 10.10.10.2
    Advertising Router: 10.10.10.2
    Sequence Number: 0x80000008
    Checksum: 0x8e26
    Length: 48

```

Figure 14: Link State Announcement ACK packet

The first LSA packet contained the list of routers the engineering router had a direct connection to. The second one contained the routes to them. and The final packet was an ACK from the core router to verify it recieved the data