TTM4150 - Lab 1

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1   Introduction

GNS3 is used to emulate routers running IOS firmware as well as links, switches
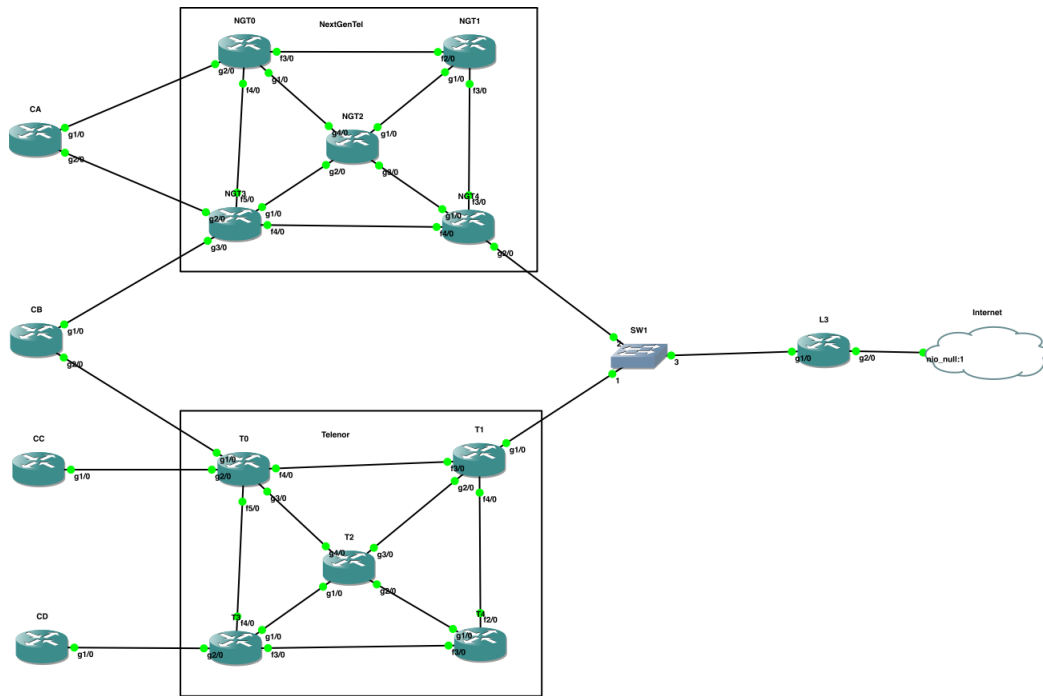etc. It also allows the emulated devices to connect with real devices.

Figure 1: Our emulated network in GNS3

2 Configuration

2.1 IP Plan

The overall IP plan is found below:

Network	IP space
Level 3	172.16.1.0/24
NextGenTel	10.10.10.0/24
	100.100.100.0/24
	192.168.10.0/24
	192.168.100.0/24
Telenor	20.20.20.0/24
	200.200.200.0/24
	192.168.20.0/24
	192.168.200.0/24
Customer A	2.2.2.0/24
	3.3.3.0/24
Customer B	4.4.4.0/24
	5.5.5.0/24
Customer C	6.6.6.0/24
	7.7.7.0/24
Customer D	8.8.8.0/24
	9.9.9.0/24

All link addresses in the entire network uses a 30 bit mask.

2.1.1 NextGenTel internal links

Router	Port	IP
NGT0	f3/0	10.10.10.1
NGT0	f4/0	10.10.10.14
NGT0	g1/0	10.10.10.17
NGT1	f3/0	10.10.10.5
NGT1	f2/0	10.10.10.2
NGT1	g1/0	10.10.10.21
NGT2	g1/0	10.10.10.22
NGT2	g2/0	10.10.10.30
NGT2	g3/0	10.10.10.26
NGT2	g4/0	10.10.10.18
NGT3	f4/0	10.10.10.10
NGT3	f5/0	10.10.10.13
NGT3	g1/0	10.10.10.29
NGT4	f3/0	10.10.10.6
NGT4	f4/0	10.10.10.9
NGT4	g1/0	10.10.10.25

2.1.2 Telenor internal links

Router	Port	IP
t0	f4/0	20.20.20.1
t0	f5/0	20.20.20.30
t0	g3/0	20.20.20.17
t1	f4/0	20.20.20.5
t1	f3/0	20.20.20.2
t1	g2/0	20.20.20.21
t2	g1/0	20.20.20.30
t2	g2/0	20.20.20.26
t2	g3/0	20.20.20.22
t2	g4/0	20.20.20.18
t3	f3/0	20.20.20.10
t3	f4/0	20.20.20.13
t3	g1/0	20.20.20.29
t4	f3/0	20.20.20.9
t4	f2/0	20.20.20.6
t4	g1/0	20.20.20.21

2.1.3 Customer links

Router	Port	IP
CA	g1/0	100.100.100.1
CA	g2/0	100.100.100.5
NGT0	g2/0	100.100.100.2
NGT3	g2/0	100.100.100.6
CB	g1/0	100.100.100.9
CB	g2/0	100.100.100.5
NGT3	g3/0	100.100.100.10
T0	g1/0	200.200.200.2
CC	g1/0	200.200.200.5
CD	g1/0	200.200.200.9

2.1.4 Loopback interfaces

Router	Loop	IP
L3	0	1.1.1.1
CA	0	2.2.2.2
CA	1	3.3.3.3
CB	0	4.4.4.4
CB	1	5.5.5.5
CC	0	6.6.6.6
CC	1	7.7.7.7
CD	0	8.8.8.8
CD	1	9.9.9.9
NGT0	0	192.168.10.1
NGT0	1	192.168.100.1
NGT1	0	192.168.10.2
NGT1	1	192.168.100.2
NGT2	0	192.168.10.3
NGT2	1	192.168.100.3
NGT3	0	192.168.10.4
NGT3	1	192.168.100.4
NGT4	0	192.168.10.5
NGT4	1	192.168.100.5
T0	0	192.168.20.1
T0	1	192.168.200.1
T1	0	192.168.20.2
T1	1	192.168.200.2
T2	0	192.168.20.3
T2	1	192.168.200.3
T3	0	192.168.20.4
T3	1	192.168.200.4
T4	0	192.168.20.5
T4	1	192.168.200.5

2.1.5 ISP links

Router	Port	IP
L3	g1/0	172.16.1.3
NGT4	g2/0	172.16.1.1
T1	g1/0	172.16.1.2

2.2 OSPF

The following shows the configuration of OSPF on the "NGT1" (NextGenTel 1) router

```
router ospf 10
 router-id 192.168.10.1
 log-adjacency-changes
 auto-cost reference-bandwidth 1000
 network 10.10.10.0 0.0.0.255 area 0
 network 100.100.100.0 0.0.0.255 area 0
 network 172.16.1.0 0.0.0.255 area 0
```

2.3   BGP

The following shows the configuration of BGP on the "CA" (Customer A) router

```
router bgp 65001
 bgp log-neighbor-changes
 neighbor 100.100.100.2 remote-as 15659
 neighbor 100.100.100.6 remote-as 15659
 !
 address-family ipv4
 redistribute ospf 10 metric 10
 neighbor 100.100.100.2 activate
 neighbor 100.100.100.6 activate
 no auto-summary
 no synchronization
 network 2.2.2.2 mask 255.255.255.255
 network 3.3.3.3 mask 255.255.255.255
 exit-address-family
```

2.4   EIGRP

```
router eigrp <AS-ID>
 redistribute ospf <ID> metric 10 0 255 1 1500
 network 0.0.0.0 255.255.255.255
 auto-summary
```

2.5   RIPv2

```
router rip
 version 2
 network 0.0.0.0
```

2.6   Redistribution

At every node that needs to bridge routing algorithms (NGT0, NGT3, NGT4, T0, T1, T3) the routes are redistributed.

2.6.1 Redistribute OSPF to BGP

```
redistribute ospf <ID> metric 10
```

2.6.2 Redistribute BGP to OSPF

```
redistribute bgp <AS-NUMBER> metric 10 subnets
```

2.6.3 Redistribute OSPF to EIGRP

```
redistribute ospf <ID> metric 10 0 255 1 1500
```

2.6.4 Redistribute BGP to EIGRP

```
redistribute bgp <AS-NUMBER> metric 10 1 255 255 1500
```

2.6.5 Redistribute OSPF to RIPv2

```
redistribute ospf <ID> metric 10
```

2.7 Cost

By setting the following on the routers utilizing OSPF we were able to adjust the cost of the interfaces so that Gigabit interfaces are prefered over Fast Ethernet interfaces.

```
auto-cost reference-bandwidth 1000
```

This is verified by looking at the cost set on the interfaces by the router

```
T0#sh ip ospf interface brief
Interface    PID    Area        IP Address/Mask    Cost  State Nbrs F/C
Lo1          20     0           192.168.200.1/32   1     LOOP  0/0
Lo0          20     0           192.168.20.1/32    1     LOOP  0/0
Fa4/0        20     0           20.20.20.1/30      10    DR    0/0
Gi3/0        20     0           20.20.20.17/30     1     BDR   1/1
Gi2/0        20     0           200.200.200.6/30   1     DR    0/0
Gi1/0        20     0           200.200.200.2/30   1     DR    0/0
```

3 Results

3.1 Traceroutes

3.1.1 Traceroute from Customer D to Level 3

```
CD#traceroute 172.16.1.3
```

```
Type escape sequence to abort.
```

```
Tracing the route to 172.16.1.3

  1  *
     200.200.200.10 40 msec 32 msec
  2 20.20.20.30 64 msec 60 msec 64 msec
  3 20.20.20.21 64 msec 88 msec 64 msec
  4 172.16.1.3 120 msec 96 msec 92 msec
```

3.1.2   Traceroute from Telenor to NextGenTel

```
T0#traceroute 10.10.10.29

Type escape sequence to abort.
Tracing the route to 10.10.10.29

  1 20.20.20.18 16 msec 24 msec 32 msec
  2 20.20.20.21 12 msec 28 msec 28 msec
  3 172.16.1.1 64 msec 48 msec 100 msec
  4 10.10.10.26 56 msec 52 msec 76 msec
  5 10.10.10.29 132 msec 72 msec 56 mse
```

3.2   IP Route

3.2.1   IP Route table on NextGenTel router

```
NGT1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     200.200.200.0/24 is variably subnetted, 4 subnets, 2 masks
O       200.200.200.8/30 [110/6] via 10.10.10.22, 01:19:53, GigabitEthernet1/0
O       200.200.200.0/30 [110/6] via 10.10.10.22, 01:19:53, GigabitEthernet1/0
O E2    200.200.200.0/24 [110/1] via 10.10.10.22, 01:19:53, GigabitEthernet1/0
O       200.200.200.4/30 [110/6] via 10.10.10.22, 01:19:53, GigabitEthernet1/0
     2.0.0.0/32 is subnetted, 1 subnets
O E2    2.2.2.2 [110/1] via 10.10.10.22, 01:19:53, GigabitEthernet1/0
     100.0.0.0/30 is subnetted, 3 subnets
O       100.100.100.4 [110/3] via 10.10.10.22, 01:19:53, GigabitEthernet1/0
O       100.100.100.0 [110/3] via 10.10.10.22, 01:19:53, GigabitEthernet1/0
```

```
O        100.100.100.8 [110/3] via 10.10.10.22, 01:19:53, GigabitEthernet1/0
      3.0.0.0/32 is subnetted, 1 subnets
O E2    3.3.3.3 [110/1] via 10.10.10.22, 01:19:53, GigabitEthernet1/0
      4.0.0.0/32 is subnetted, 1 subnets
O E2    4.4.4.4 [110/1] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
      20.0.0.0/8 is variably subnetted, 9 subnets, 2 masks
O        20.20.20.20/30 [110/4] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O        20.20.20.16/30 [110/5] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O        20.20.20.28/30 [110/5] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O        20.20.20.24/30 [110/5] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O        20.20.20.4/30 [110/4] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O        20.20.20.0/30 [110/15] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O E2    20.0.0.0/8 [110/1] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O        20.20.20.12/30 [110/15] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O        20.20.20.8/30 [110/15] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
      5.0.0.0/32 is subnetted, 1 subnets
O E2    5.5.5.5 [110/1] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
      192.168.10.0/32 is subnetted, 1 subnets
C        192.168.10.2 is directly connected, Loopback0
O E2 6.0.0.0/8 [110/1] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
      172.16.0.0/24 is subnetted, 1 subnets
O        172.16.1.0 [110/3] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O E2 7.0.0.0/8 [110/1] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
      192.168.200.0/24 is variably subnetted, 3 subnets, 2 masks
O E2    192.168.200.0/24 [110/1] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O E2    192.168.200.1/32 [110/1] via 10.10.10.22, 01:19:54, GigabitEthernet1/0
O E2    192.168.200.4/32
            [110/20] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
O E2 8.0.0.0/8 [110/20] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
O E2 9.0.0.0/8 [110/20] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
      192.168.20.0/24 is variably subnetted, 3 subnets, 2 masks
O E2    192.168.20.4/32 [110/20] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
O E2    192.168.20.0/24 [110/1] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
O E2    192.168.20.1/32 [110/1] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
      10.0.0.0/30 is subnetted, 8 subnets
O        10.10.10.8 [110/12] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
O        10.10.10.12 [110/12] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
C        10.10.10.0 is directly connected, FastEthernet2/0
C        10.10.10.4 is directly connected, FastEthernet3/0
O        10.10.10.24 [110/2] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
O        10.10.10.28 [110/2] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
O        10.10.10.16 [110/2] via 10.10.10.22, 01:19:55, GigabitEthernet1/0
C        10.10.10.20 is directly connected, GigabitEthernet1/0
      192.168.100.0/32 is subnetted, 1 subnets
C        192.168.100.2 is directly connected, Loopback1
```