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Communication Services and Security
Exercise 3 - Problem 3

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1 Implemented Topology

Figure 8 shows the structure of the implemented topology.

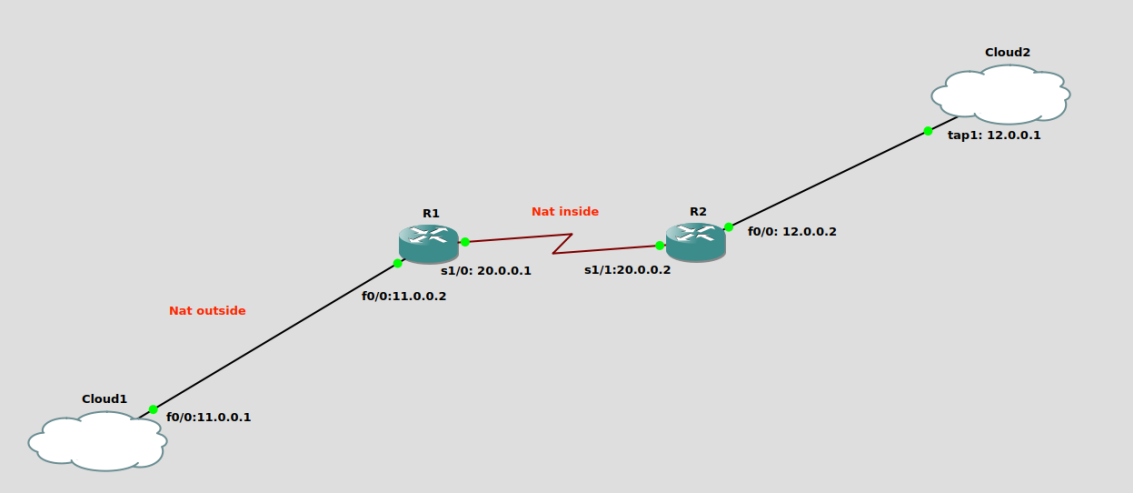

Figure 1: Implemented Topology

2 Configurations

To implement the presented topology where added the following commands on the different elements.

2.1 Host Computer

Is attached as "tab-script.sh" and configures the taps and adds routes.

```
#!/bin/bash
sudo tunctl -t tap0 -u radu
sudo tunctl -t tap1 -u radu
sudo ip link set tap0 up
sudo ip link set tap1 up
ip add add 11.0.0.1/24 dev tap0
ip add add 12.0.0.1/24 dev tap1
route add -net 13.0.0.0/24 gw 11.0.0.2 dev tap0
route add -net 20.0.0.0/24 gw 11.0.0.2 dev tap0
route add -net 14.0.0.0/24 gw 12.0.0.2 dev tap1
```

2.2 R1

1. Priority list

```
priority-list 1 protocol ip high udp 5004
priority-list 1 default low
```

2. Default Routes

```
ip route 11.0.0.0 255.255.255.0 20.0.0.1
ip route 13.0.0.0 255.255.255.0 12.0.0.1
ip route 14.0.0.0 255.255.255.0 11.0.0.1
```

3. Nat Configuration

```
ip nat inside source static 12.0.0.1 13.0.0.1
ip nat outside source static 11.0.0.1 14.0.0.1
```

4. Interaface Fast Etherent 0/0

```
ip address 11.0.0.2 255.255.255.0
ip nat outside
ip virtual-reassembly
no shutdown
half duplex
```

5. Interaface Serial 1/0

```
ip address 20.0.0.1 255.255.255.0
ip nat inside
priority-group 1
ip virtual-reassembly
serial restart-delay 0
no shutdown
```

2.3 R2

Default Routes

```
ip route 11.0.0.0 255.255.255.0 20.0.0.1
ip route 13.0.0.0 255.255.255.0 12.0.0.1
ip route 14.0.0.0 255.255.255.0 11.0.0.1
```

Interaface Fast Etherent 0/0

```
ip address 12.0.0.2 255.255.255.0
no shutdouw
duplex half
```

Interaface Serial 1/0

```
ip address 20.0.0.2 255.255.255.0
serial restart-delay 0
no shutdown
```

3 Questions

3.1 Q-1

Detail the required NAT related R1 configuration as well as the correct routing directives on your PC. Note that video stream must be delivered from 11.0.0.1 to 13.0.0.1 .

After executing the previous mentioned script "tab-script.sh", the routing directives in the host PC are:

```
radu@radu-TM1701:~/PycharmProjects/CommunicationServicesAndSecurity/Lab 3/Problem 3$ route
Tabla de rutas IP del núcleo
Destino         Pasarela        Genmask         Indic Métric Ref    Uso Interfaz
default         mygpon          0.0.0.0         UG    600    0        0 wlp3s0
11.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 tap0
12.0.0.0        0.0.0.0         255.255.255.0   U     0      0        0 tap1
13.0.0.0        11.0.0.2        255.255.255.0   UG    0      0        0 tap0
14.0.0.0        12.0.0.2        255.255.255.0   UG    0      0        0 tap1
20.0.0.0        11.0.0.2        255.255.255.0   UG    0      0        0 tap0
link-local      0.0.0.0         255.255.0.0     U     1000   0        0 wlp3s0
192.168.0.0     0.0.0.0         255.255.255.0   U     600    0        0 wlp3s0
192.168.122.0   0.0.0.0         255.255.255.0   U     0      0        0 virbr0
```

Figure 2: Host routes.

To configure properly the two NATs, first we defined the routes:

```
ip route 11.0.0.0 255.255.255.0 20.0.0.1
ip route 13.0.0.0 255.255.255.0 12.0.0.1
ip route 14.0.0.0 255.255.255.0 11.0.0.1
```

Then for the R1 we added the tranlation of the inside and outside source:

```
ip nat inside source static 12.0.0.1 13.0.0.1
ip nat outside source static 11.0.0.1 14.0.0.1
```

While doing a ping from the host computer the result for the "show ip nat translations":

```
R1#show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
--- ---                ---                14.0.0.1           11.0.0.1
icmp 13.0.0.1:7        12.0.0.1:7         14.0.0.1:7         11.0.0.1:7
--- 13.0.0.1           12.0.0.1           ---                ---
R1#
```

Figure 3: NAT configuration.

3.2 Q-2

Detail the required priority queuing (PQ) related R1 configuration in order to provide high priority to video streaming and low priority to default traffic. Which is the

maximum allowed speed transmission rate along the path ?

First we defined the prority group on the **Serial 1/0** interface of the R1. Then to set the priority of the video (for the group), it has been established that ip traffic using UDP through port 5004 has a high priority (As it's shown in page 50). Otherwise, the rest of the traffic has low priority.

```
priority-list 1 protocol ip high udp 5004
priority-list 1 default low
```

The maximum transmission speed along the path is aproximate 1.5 Mbps. To obtain it, was executed the following command in R1, where we can see that the accurate value is 1544 Kbit/sec:

```
$ sh int s1/0
```

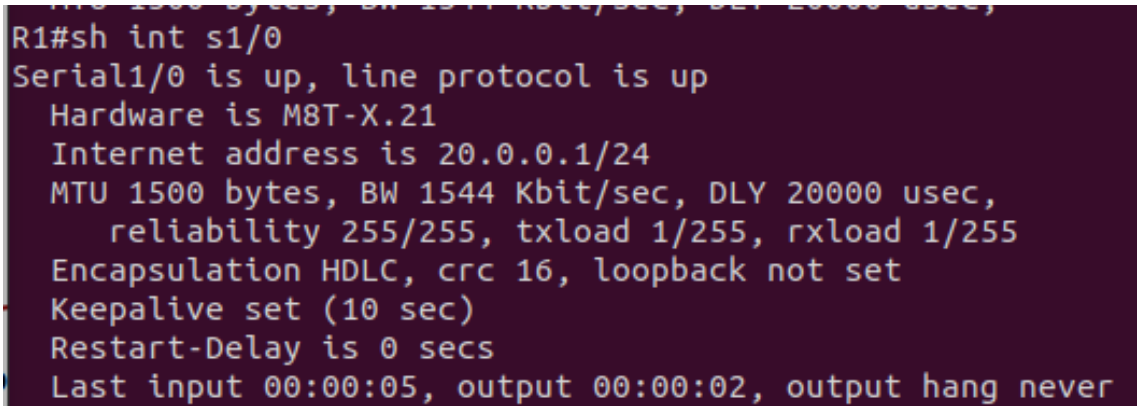

Figure 4: Speed Transmission Rate.

3.3 Q-3

Download from here a video sample with the corresponding video bit rate encoding slightly below your maximum transmission rate. Detail the complete ping to achieve the same transmission rate that your video streaming.

According to the maximum transmission speed along the path 1.5 Mbps, determinated in the previous question. We selected the following video with the detailed characteristics:

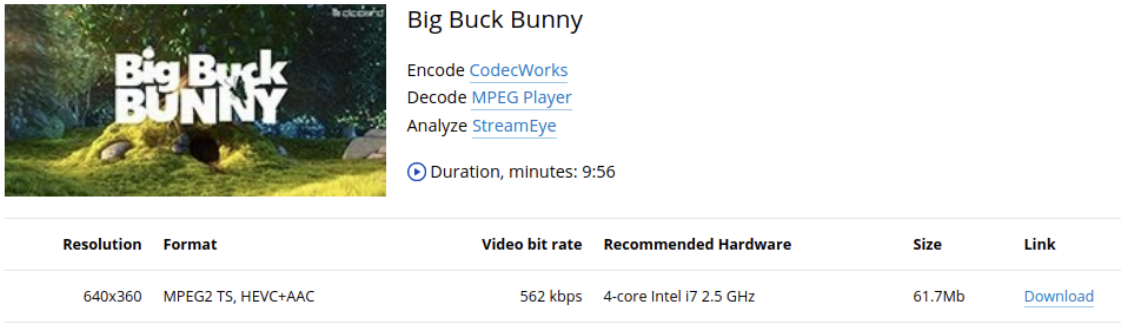

Figure 5: Video Sample.

The used ping to achieve the same transmission rate:

```
$ sudo ping 13.0.0.1 -s 7025 -i 0,1
```

Were we send 7025 bytes every 0.1 seconds, which is equivalent to the video bit rate shown in the previous picture of 562kbs.

3.4 Q-4

While streaming video, measure the number of RTP missed packets (during 1 minute of transmission) by ffplayer when using PQ and without PQ. Explain how you obtain those measurements.

To achieve the transmission we executed the following commands in 2 different terminals.

```
$ ffmpeg -re -i bbb_360p_c.ts -vcodec copy -an -sdp_file s.sdp -f rtp rtp:/13.0.0.1:5004
$ ffplay -protocol_whitelist file,udp,rtp -i s.sdp 2> filename.txt
```

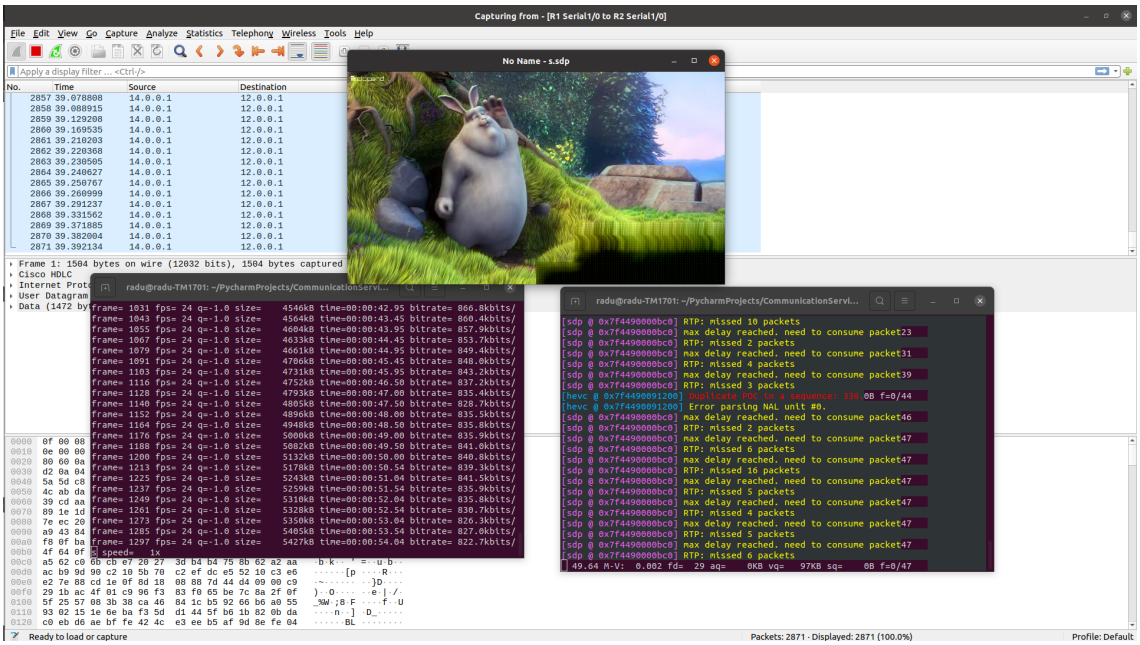

Figure 6: Transmission example.

The output of the **ffplay** was saved in different text files for this exercices requirements and for the next exercice. To obtain the results without PQ the config line "*priority-group 1*" was removed from the Serial interface of the R1.

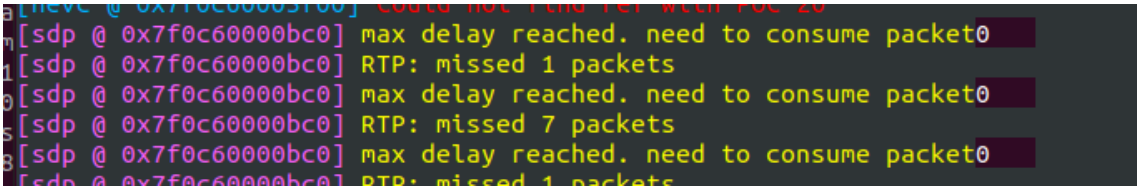

Figure 7: RTP missed packets examples.

Then, we implement a script "rtp_script.py" which computes the total of RTP missed packets from the files generated.

```
/home/radu/PycharmProjects/CommunicationServicesAnd
PQ - No Ping. RTP missed packets:  1385
NO PQ - No Ping. RTP missed packets:  1374
PQ - Ping. RTP missed packets:  1647
NO PQ - Ping. RTP missed packets:  2490
```

Figure 8: Script output.

The final results are:

	Packets Lost
PQ without ping	1385
NO PQ without ping	1374

3.5 Q-5

Repeat the last item adding a ping transmission at the same rate that the video streaming.
To achieve the required behaviour we used the previous shown ping:

```
$ sudo ping 13.0.0.1 -s 7025 -i 0,1
```

The obtained results were:

	Packets Lost
PQ with ping	1647
NO PQ with ping	2490

As was expected when the PQ is activated the number of packets lost it's lower than without it. In the folder are also attached all the generated files from which were computed the presented results.