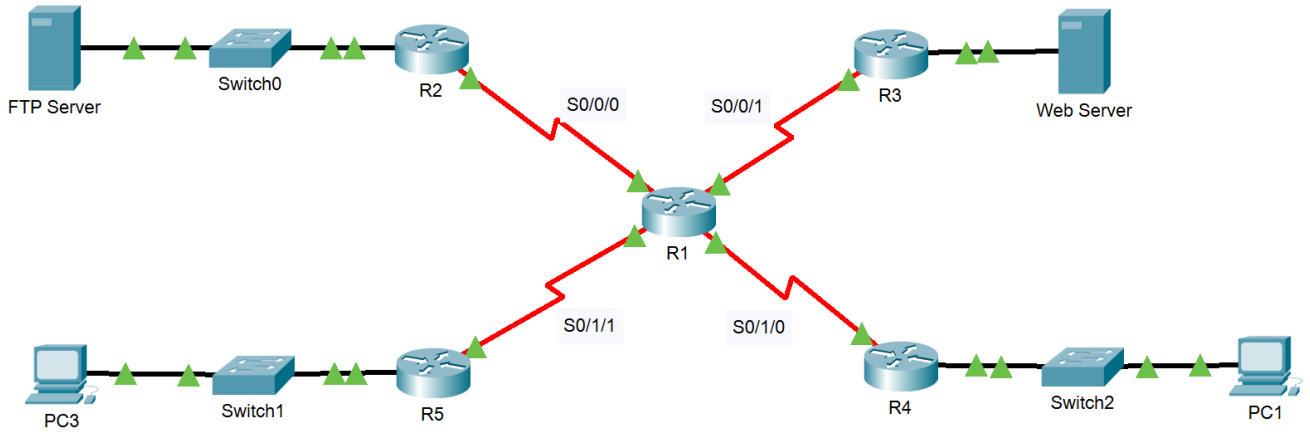
PRAKTIKUM
DESAIN DAN MANAJEMEN JARINGAN KOMPUTER

Nama	**Aliyah Rizky Al-Afifah Polanda**	**No. Modul**	**06**
NPM	**2206024682**	**Tipe**	**Tugas Tambahan**

1. Topologi jaringan.



2. *Addressing table.*

X = 6; Y = 8; Z = 2.

Device	Interface	IP Address	Subnet	Default Gateway
R1	S0/0/0	10.10.6.1	/30	
	S0/0/1	10.10.8.1	/30	
	S0/1/0	11.11.6.1	/30	
	S0/1/1	11.11.8.1	/30	
R2	S0/0/0	10.10.6.2	/30	
	G0/0	192.168.68.1	/24	
R3	S0/0/1	10.10.8.2	/30	

	G0/0	192.168.62.1	/24	
R4	S0/1/0	11.11.6.2	/30	
	G0/0	192.168.66.1	/24	
R5	S0/1/1	11.11.8.2	/30	
	G0/0	192.168.82.1	/24	
PC1	F0	192.168.66.254	/24	192.168.66.1
PC3		192.168.82.254	/24	192.168.82.1
FTP Server		192.168.68.254	/24	192.168.68.1
Web Server		192.168.62.254	/24	192.168.62.1

3. Konfigurasi *hostname*, *banner* motd, dan SSH *access*.

- R1:

```
Router(config)#host R1
R1(config)#banner motd "Aliyah Rizky_2206024682"
R1(config)#ip domain-n netlab.com
R1(config)#user netlab pass cisco
R1(config)#crypto key gen rsa
R1(config)#line vty 0 4
R1(config-line)#trans in ssh
R1(config-line)#login local
R1(config)#ip ssh ver 2
```

- R2:

```
Router(config)#host R2
R2(config)#banner motd "Aliyah Rizky_2206024682"
R2(config)#ip domain-n netlab.com
R2(config)#user netlab pass cisco
R2(config)#crypto key gen rsa
R2(config)#ip ssh ver 2
R2(config)#line vty 0 4
R2(config-line)#trans in ssh
R2(config-line)#login local
```

- R3:

```
Router(config)#host R3
R3(config)#banner motd "Aliyah Rizky_2206024682"
R3(config)#ip domain-n netlab.com
R3(config)#user netlab pass cisco
R3(config)#crypto key gen rsa
R3(config)#ip ssh ver 2
```

```
R3(config)#line vty 0 4
R3(config-line)#trans in ssh
R3(config-line)#login local
```

- R4:

```
Router(config)#host R4
R4(config)#banner motd "Aliyah Rizky_2206024682"
R4(config)#ip domain-n netlab.com
R4(config)#user netlab pass cisco
R4(config)#crypto key gen rsa
R4(config)#ip ss ver 2
R4(config)#line vty 0 4
R4(config-line)#trans in ssh
R4(config-line)#login local
```

- R5:

```
hostname R5
banner motd ^CAliyah Rizky 2206024682^C

ip ssh version 2
ip domain-name netlab.com
username netlab password 0 cisco
line vty 0 4
 login local
 transport input ssh
```

4. Pengalamatan perangkat.

- R1:

```
Router(config)#int s0/0/0
Router(config-if)#ip add 10.10.6.1 255.255.255.252
Router(config-if)#no sh
Router(config-if)#int s0/0/1
Router(config-if)#ip add 10.10.8.1 255.255.255.252
Router(config-if)#no sh
Router(config-if)#int s0/1/0
Router(config-if)#ip add 11.11.6.1 255.255.255.252
Router(config-if)#no sh
Router(config-if)#int s0/1/1
Router(config-if)#ip add 11.11.8.1 255.255.255.252
Router(config-if)#no sh
```

- R2:

```
Router(config)#int s0/0/0
Router(config-if)#ip add 10.10.6.2 255.255.255.252
Router(config-if)#no sh
Router(config-if)#int g0/0
Router(config-if)#ip add 192.168.68.1 255.255.255.0
Router(config-if)#no sh
```

- R3:

```
Router(config)#int s0/0/1
Router(config-if)#ip add 10.10.8.2 255.255.255.252
Router(config-if)#no sh
```

```
Router(config-if)#int g0/0
Router(config-if)#ip add 192.168.62.1 255.255.255.0
Router(config-if)#no sh
```

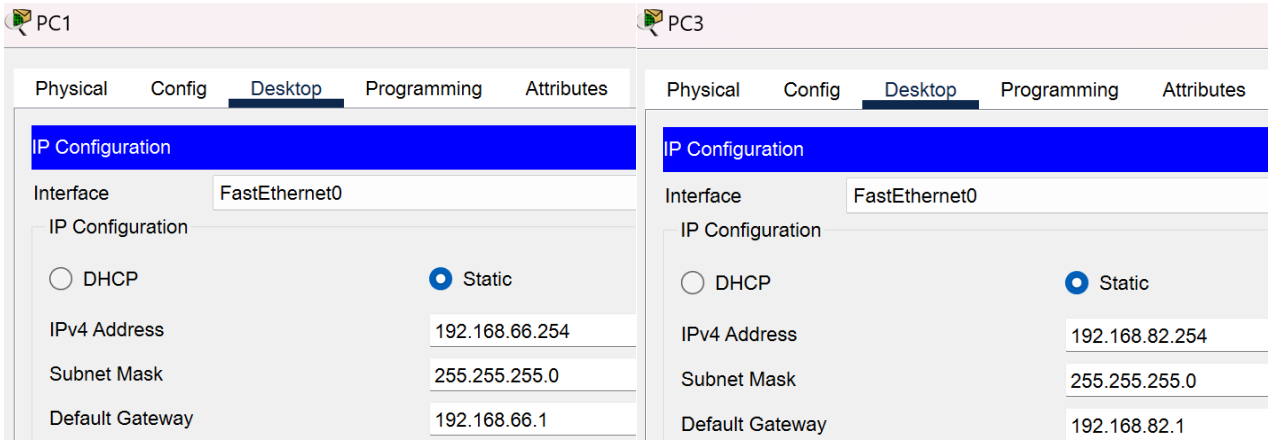
- R4:

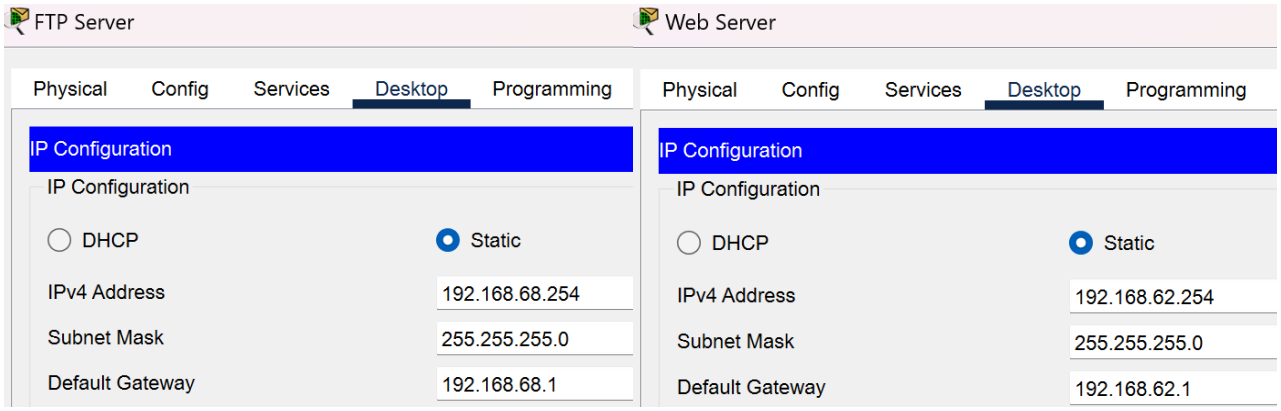
```
Router(config)#int s0/1/0
Router(config-if)#ip add 11.11.6.2 255.255.255.252
Router(config-if)#no sh
Router(config-if)#int g0/0
Router(config-if)#ip add 192.168.66.1 255.255.255.0
Router(config-if)#no sh
```

- R5:

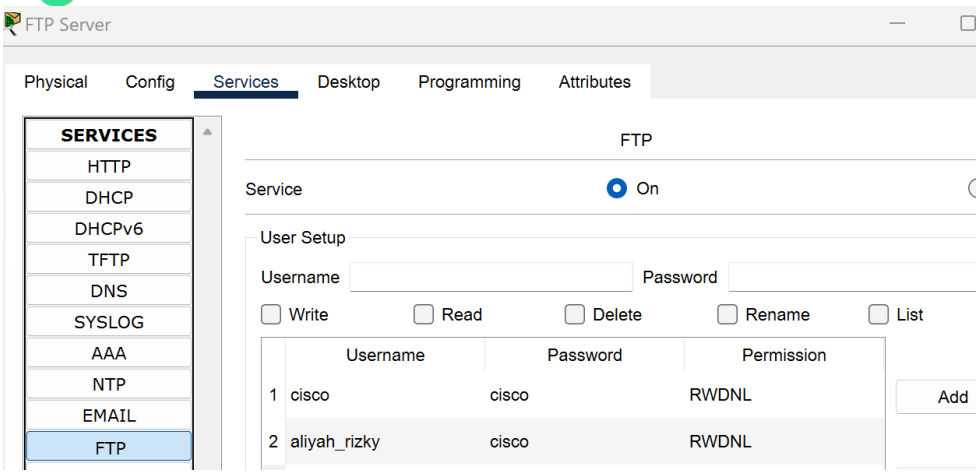
```
Router(config)#int s0/1/1
Router(config-if)#ip add 11.11.8.2 255.255.255.252
Router(config-if)#no sh
Router(config-if)#int g0/0
Router(config-if)#ip add 192.168.82.1 255.255.255.0
Router(config-if)#no sh
```

- *End devices*:





5. Mengaktifkan layanan FTP.



6. *Routing* EIGRP.

- R1:

```
R1(config)#router eigrp 5
R1(config-router)#net 10.10.6.0 0.0.0.3
R1(config-router)#net 10.10.8.0 0.0.0.3
R1(config-router)#net 11.11.6.0 0.0.0.3
R1(config-router)#net 11.11.8.0 0.0.0.3
R1(config-router)#no auto
```

- R2:

```
R2(config)#router eigrp 5
R2(config-router)#net 192.168.68.0 0.0.0.255

R2(config-router)#passive g0/0
R2(config-router)#net 10.10.6.0 0.0.0.3
R2(config-router)#no auto
```

- R3:

```
R3(config)#router eigrp 5
R3(config-router)#net 192.168.62.0 0.0.0.255
R3(config-router)#passiv g0/0
R3(config-router)#net 10.10.8.0 0.0.0.3
R3(config-router)#no auto
```

- R4:

```
R4(config)#router eigrp 5
R4(config-router)#net 192.168.66.0 0.0.0.255
R4(config-router)#passive g0/0
R4(config-router)#net 11.11.6.0 0.0.0.3
R4(config-router)#no auto
```

- R5:

```
R5(config)#router eigrp 5
R5(config-router)#net 192.168.82.0 0.0.0.255
R5(config-router)#passive g0/0
R5(config-router)#net 11.11.8.0.0.0.0.3
R5(config-router)#no auto
```

7. Cek konektivitas.

Device	*Success/Fail*		
PC1 -PC3	Successful	PC1	PC3
PC1 – FTP Server	Successful	PC1	FTP Server
PC1 – Web Server	Successful	PC1	Web Server
PC3 – FTP Server	Successful	PC3	FTP Server
PC3 – Web Server	Successful	PC3	Web Server
FTP Server – Web Server	Successful	FTP Server	Web Server

PDU berhasil dilakukan antara perangkat yang berbeda jaringan. Hal ini karena *routing* EIGRP telah diterapkan dalam topologi.

QoS Configuration: Konfigurasi di R1

1. *Extended* ACL.

   Y = 8; Z = 2.

```
R1(config)#access-list 108 permit eigrp any any
R1(config)#access-list 109 permit eigrp any any
R1(config)#access-list 108 permit tcp host 192.168.66.254 host 192.168.62.254 eq www
R1(config)#access-list 108 permit tcp host 192.168.82.254 host 192.168.62.254 eq www
R1(config)#access-list 102 permit tcp host 192.168.66.254 host 192.168.68.254 eq ftp
R1(config)#int s0/0/0
R1(config-if)#ip access-group 102 out
R1(config-if)#int s0/0/1
R1(config-if)#ip access-group 108 out
```

2. *Class map*.

```
R1(config)#class-map HTTP
R1(config-cmap)#match access 108
```

```
R1(config-cmap)#match pro http
R1(config-cmap)#class FTP
R1(config-cmap)#match access 102
R1(config-cmap)#match pro ftp
R1(config-cmap)#class IPP-5
R1(config-cmap)#match precedence crit
R1(config-cmap)#class DSCP
R1(config-cmap)#match ip dscp af31
```

Verifikasi:

```
R1#sh class-map
 Class Map match-any class-default (id 0)
   Match any
 Class Map match-all HTTP (id 1)
   Match access-group 108
   Match protocol http
 Class Map match-all FTP (id 2)
   Match access-group 102
   Match protocol ftp
 Class Map match-all IPP-5 (id 3)
   Match precedence 5
 Class Map match-all DSCP (id 4)
   Match ip dscp af31 (26)
```

3. *Policy map* menuju Web Server.

```
R1(config)#policy-map QoS-Server
R1(config-pmap)#class HTTP
R1(config-pmap-c)#band percent 40
R1(config-pmap-c)#queue-limit 1024
R1(config-pmap)#class DSCP
R1(config-pmap-c)#band percent 10
R1(config-pmap-c)#class IPP-5
R1(config-pmap-c)#band percent 10
```

Verifikasi:

```
R1#sh policy-map
  Policy Map QoS-Server
    Class HTTP
      Bandwidth 40 (%) Max Threshold 1024 (packets)
    Class DSCP
      Bandwidth 10 (%) Max Threshold 64 (packets)
    Class IPP-5
      Bandwidth 10 (%) Max Threshold 64 (packets)
```

4. *Service policy*.

```
R1(config)#int s0/0/1
R1(config-if)#service out QoS-Server
```

5. *Policy map* menuju FTP Server.

```
R1(config)#policy-map QoS-FTP
R1(config-pmap)#class FTP
R1(config-pmap-c)#band percen 40
R1(config-pmap-c)#queue 1024
R1(config-pmap-c)#class DSCP
R1(config-pmap-c)#band percen 10
R1(config-pmap-c)#class IPP-5
R1(config-pmap-c)#band percen 10
```

Verifikasi:

```
R1#sh policy-map
  Policy Map QoS-Server
    Class HTTP
      Bandwidth 40 (%) Max Threshold 1024 (packets)
    Class DSCP
      Bandwidth 10 (%) Max Threshold 64 (packets)
    Class IPP-5
      Bandwidth 10 (%) Max Threshold 64 (packets)
  Policy Map QoS-FTP
    Class FTP
      Bandwidth 40 (%) Max Threshold 1024 (packets)
    Class DSCP
      Bandwidth 10 (%) Max Threshold 64 (packets)
    Class IPP-5
      Bandwidth 10 (%) Max Threshold 64 (packets)
```

6. *Service policy*.

```
R1(config-if)#service out QoS-FTP
R1(config-if)#ex
```

7. Verifikasi *policy map*.

- *Interface* S0/0/0:

```
R1#sh policy-map int s0/0/0
 Serial0/0/0

  Service-policy output: QoS-FTP

    Class-map: FTP (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: access-group 102
      Match: protocol ftp
      Queueing
        Output Queue: Conversation 265
        Bandwidth 40 (%)
        Bandwidth 617 (kbps)Max Threshold 1024 (packets)
        (pkts matched/bytes matched) 0/0
        (depth/total drops/no-buffer drops) 0/0/0

    Class-map: DSCP (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: ip dscp af31 (26)
      Queueing
        Output Queue: Conversation 266
        Bandwidth 10 (%)
        Bandwidth 154 (kbps)Max Threshold 64 (packets)
        (pkts matched/bytes matched) 0/0
        (depth/total drops/no-buffer drops) 0/0/0

    Class-map: IPP-5 (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: precedence 5
      Queueing
        Output Queue: Conversation 267
        Bandwidth 10 (%)
        Bandwidth 154 (kbps)Max Threshold 64 (packets)
        (pkts matched/bytes matched) 0/0
        (depth/total drops/no-buffer drops) 0/0/0

    Class-map: class-default (match-any)
      20 packets, 1680 bytes
      5 minute offered rate 50 bps, drop rate 0 bps
      Match: any
```

Hasil di atas menunjukkan penerapan kebijakan layanan (*service policy*) pada antarmuka S0/0/0 dengan nama QoS-FTP. Terdapat tiga kelas kustom dan satu kelas *default* yang aktif, yaitu FTP, DSCP, IPP-5, dan class-default. Setiap kelas dilengkapi dengan informasi tentang konfigurasi kelas, alokasi *bandwidth*, dan konfigurasi antrian (*queuing*). Jumlah paket yang sesuai dengan setiap kelas juga dihitung. Untuk kelas FTP, DSCP, dan IPP-5, belum ada paket yang sesuai dengan kriteria, sehingga jumlah paketnya adalah 0. Namun, untuk class-default, terdapat 20 paket yang cocok dengan kriteria kelas tersebut.

- *Interface* S0/0/1:

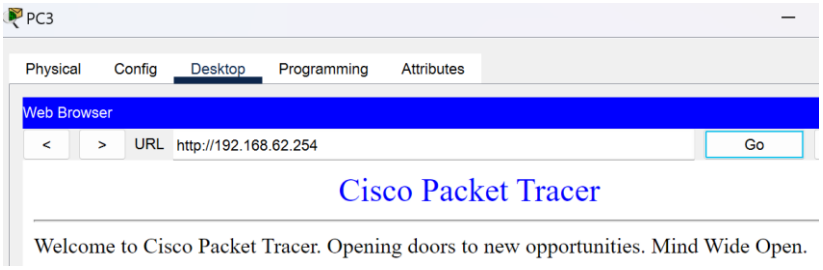
```
R1#sh policy-map int s0/0/1
 Serial0/0/1

  Service-policy output: QoS-Server

    Class-map: HTTP (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: access-group 108
      Match: protocol http
      Queueing
        Output Queue: Conversation 265
        Bandwidth 40 (%)
        Bandwidth 617 (kbps)Max Threshold 1024 (packets)
        (pkts matched/bytes matched) 0/0
        (depth/total drops/no-buffer drops) 0/0/0

    Class-map: DSCP (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: ip dscp af31 (26)
      Queueing
        Output Queue: Conversation 266
        Bandwidth 10 (%)
        Bandwidth 154 (kbps)Max Threshold 64 (packets)
        (pkts matched/bytes matched) 0/0
        (depth/total drops/no-buffer drops) 0/0/0

    Class-map: IPP-5 (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: precedence 5
      Queueing
        Output Queue: Conversation 267
        Bandwidth 10 (%)
        Bandwidth 154 (kbps)Max Threshold 64 (packets)
        (pkts matched/bytes matched) 0/0
        (depth/total drops/no-buffer drops) 0/0/0

    Class-map: class-default (match-any)
      43 packets, 3300 bytes
      5 minute offered rate 82 bps, drop rate 0 bps
      Match: any
```

Informasi yang ditampilkan pada *interface* S0/0/1 hampir sama dengan informasi pada *policy-map* yang diterapkan pada *interface* S0/0/0. Namun, pada *interface* S0/0/1, kelas-kelas yang digunakan dalam kebijakan layanan adalah HTTP, DSCP, dan IPP-5. Saat ini, belum ada paket yang cocok dengan kelas-kelas tersebut karena belum ada perangkat yang sesuai dengan kriteria yang dikonfigurasikan. Sebagai hasilnya, paket-paket yang terdeteksi akan masuk ke dalam class-default, yaitu kelas yang menghitung paket-paket yang tidak sesuai dengan kriteria kelas lainnya.

- “Understand Packet Counters in Service Policy Interface Output,”cisco.com, Mar. 2023. [Online]. Available: https://www.cisco.com/c/en/us/support/docs/quality-of-service-qos/qos-congestion-avoidance/10107-showpolicy.html. [Accessed Apr. 20, 2024].

8. Akses Web Server dari PC3.

Hasil:



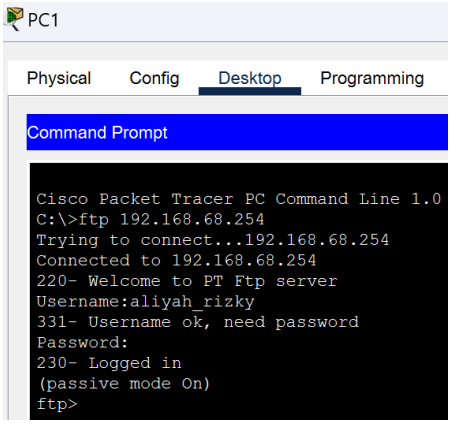
Perubahan:

```
R1#sh policy-map int s0/0/1
 Serial0/0/1

  Service-policy output: QoS-Server

    Class-map: HTTP (match-all)
      5 packets, 205 bytes
      5 minute offered rate 10 bps, drop rate 0 bps
      Match: access-group 108
      Match: protocol http
      Queueing
        Output Queue: Conversation 265
        Bandwidth 40 (%)
        Bandwidth 617 (kbps)Max Threshold 1024 (packets)
        (pkts matched/bytes matched) 0/0
        (depth/total drops/no-buffer drops) 0/0/0

    Class-map: class-default (match-any)
      90 packets, 6840 bytes
      5 minute offered rate 128 bps, drop rate 0 bps
      Match: any
```

Terjadi perubahan pada *class-map* HTTP dan class-default. Jumlah paket yang sesuai dengan kriteria pada *class-map* HTTP bertambah menjadi 5, yang meliputi paket *request* ke Web Server dan paket respons dari Web Server. Selain itu, hasil menunjukkan bahwa tidak ada paket yang dijatuhkan selama proses berlangsung. Pertambahan jumlah paket pada class-default terjadi karena adanya pertukaran paket *routing* atau paket hello yang dilakukan secara berkala antar router.

9. Akses FTP Server dari PC1.

Hasil:



Perubahan:

```
R1#sh policy-map int s0/0/0
 Serial0/0/0

  Service-policy output: QoS-FTP

    Class-map: FTP (match-all)
      7 packets, 286 bytes
      5 minute offered rate 14 bps, drop rate 0 bps
      Match: access-group 102
      Match: protocol ftp
      Queueing
        Output Queue: Conversation 265
        Bandwidth 40 (%)                              Class-map: class-default (match-any)
        Bandwidth 617 (kbps)Max Threshold 1024 (packets)  115 packets, 8812 bytes
        (pkts matched/bytes matched) 0/0                  5 minute offered rate 163 bps, drop rate 0 bps
        (depth/total drops/no-buffer drops) 0/0/0         Match: any
```

PC1 mengakses layanan FTP, paket akan melewati R1, sehingga terjadi pertambahan jumlah paket yang sesuai dengan *class-map* FTP. Tidak ada paket yang dijatuhkan selama proses berlangsung. Sama seperti sebelumnya, class-default mengalami perubahan karena adanya pertukaran paket secara berkala antara *router* dalam topologi.

10. *Average shaping*.

```
R1(config)#policy QoS-Server
R1(config-pmap)#class HTTP
R1(config-pmap-c)#shape average 150000
R1(config-pmap-c)#class FTP
R1(config-pmap-c)#shape average 150000
R1(config)#policy QoS-FTP
R1(config-pmap)#class HTTP
R1(config-pmap-c)#shape average 150000
R1(config-pmap-c)#class FTP
R1(config-pmap-c)#shape average 150000
```

11. *Traffic shaping* digunakan untuk mengatur *bandwidth* jaringan demi menjamin QOS dalam jaringan. *Average shaping* merupakan salah satu mekanisme untuk menerapkan *traffic shaping*, dimana pengaturan akan berdasarkan pada rata-rata kecepatan pengiriman data dalam periode waktu tertentu. Dampak dari diterapkannya shaping pada lalu lintas HTTP dan FTP adalah kecepatan pengiriman data dapat diatur, menghindari penyalahgunaan *bandwidth*, dan memastikan distribusi yang adil antara layanan yang berbeda. Selain itu *shaping* dapat mengelola latensi dengan mengatur laju pengiriman data secara konsisten dan mencegah penumpukan paket pada antarmuka jaringan, sehingga dapat menjaga kinerja jaringan secara keseluruhan. Namun, *traffic shaping* juga dapat memberikan dampak buruk seperti meingkatnya *delay* dalam pengiriman paket, terutama saat lalu lintas melebihi batas *shaping* yang ditetapkan.

Referensi:

- “Traffic Shaping,” geeksforgeeks.org, Aug. 2022. [Online]. Available: https://geeksforgeeks.org/traffic-shaping/. [Accessed Apr. 20, 2024].