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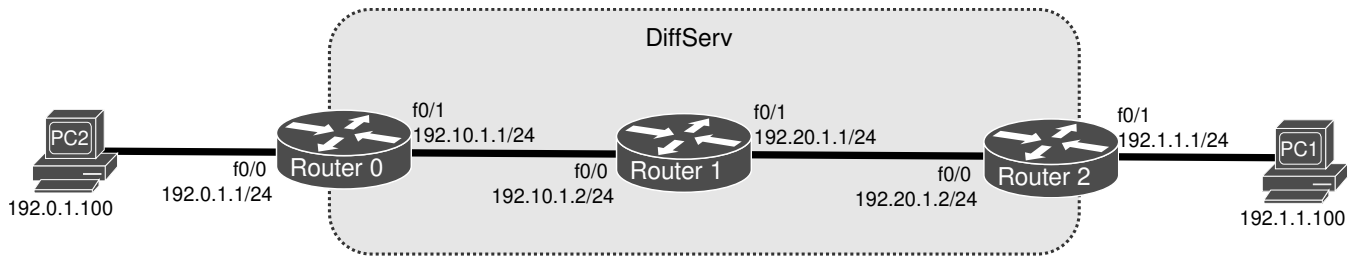
ARQUITETURA DE COMUNICAÇÕES

LABORATORY GUIDE

DIFFSERV ARCHITECTURE

Implementing DiffServ for end-to-end QoS

Set up the following network. Configure the IP addresses at the routers' interfaces and configure the necessary routing mechanisms (e.g., OSPF) in order to have full connectivity. For simplicity reasons, traffic will be unidirectional, from PC1 to PC2.



1. Consider 4 traffic classes with the following characteristics and requirements:

- **Premium class** will be marked with a **DSCP value of 46 (EF)**.
- **Gold class** will be marked with a **DSCP value of 10 (AF11, low drop probability)**.
- **Silver class** will be marked with a **DSCP value of 22 (AF23, high drop probability)**.
- Everything else is considered as belonging to the **“best-effort”** traffic class.
- The premium class should be forwarded with the lowest delay possible up to a maximum of 10% of the link bandwidth during periods of congestion.
- The gold class should be treated preferentially over the silver class.
- The gold and silver classes should have 20 percent and 15 percent, respectively, of the interface bandwidth as the minimum bandwidth guarantees.
- Best-effort class should be policed to 512 kbps.

2. Defining Classes and classifying packets

The different services will be emulated generating traffic from PC1 to PC2 using a specific port number. In order to classify traffic in the different classes, three extended access lists (where the port numbers for the different services vary from 3001 to 3003) must be defined at Router 2:

```
Router2(config)#access-list 101 permit udp any any eq 3001
Router2(config)#access-list 102 permit udp any any eq 3002
Router2(config)#access-list 103 permit udp any any eq 3003
```

```
Router2(config)#class-map match-all EF
Router2(config-cmap)#match access-group 101
Router2(config)#class-map match-all AF11
Router2(config-cmap)#match access-group 102
Router2(config)#class-map match-all AF23
Router2(config-cmap)#match access-group 103
```

3. Configure the SETDSCP policy map in order to **mark packets** according to the previously described scheme:

```
Router2(config)#policy-map SETDSCP
Router2(config-pmap)#class EF
Router2(config-pmap-c)#set ip dscp 46
Router2(config-pmap)#class AF11
Router2(config-pmap-c)#set ip dscp 10
Router2(config-pmap)#class AF23
Router2(config-pmap-c)#set ip dscp 22
```

Apply this policy map in the **input** direction of interface f0/1 of Router 2 by using the following command:

```
service-policy input SETDSCP
```

4. Start a capture at network 192.20.1.0/24. In order to emulate the different services, execute the following commands at PC1:

```
ping 192.0.1.100 -2 -p 3001
ping 192.0.1.100 -2 -p 3002
ping 192.0.1.100 -2 -p 3003
ping 192.0.1.100 -2 -p 3004
```

By looking at the captured packets, confirm the DSCP values that were set at the edge of the DiffServ network.

5. In order to configure the different **per hop behavior (PHB)** match the different DSCP values to the traffic classes and create the EDGE policy map:

```
Router2(config)#class-map match-all PREMIUM
Router2(config-cmap)#match ip dscp 46
Router2(config)#class-map match-all GOLD
Router2(config-cmap)#match ip dscp 10
Router2(config)#class-map match-all SILVER
Router2(config-cmap)#match ip dscp 22
Router2(config)#class-map match-all BEST-EFFORT
Router2(config-cmap)#match ip dscp 0
---
Router2(config)#policy-map EDGE
Router2(config-pmap)#class PREMIUM
Router2(config-pmap)#priority percent 10
Router2(config-pmap)#class GOLD
Router2(config-pmap)#bandwidth percent 20
Router2(config-pmap)#class SILVER
Router2(config-pmap)#bandwidth percent 15
Router2(config-pmap)#class BEST-EFFORT
Router2(config-pmap)#police 512000 100000 100000 conform-action set-dscp-transmit 0
                                     (rate limit of 512Kbps; normal burst of 100Kbytes and maximum burst of 100Kbytes)
```

Apply this policy map in the **output** direction of interface f0/0 of Router 2 by using the following command:

```
service-policy output EDGE
```

6. At the core router (Router 1), traffic classes correspond to the service classes that were already defined at the edge router.

```
Router1(config)#class-map match-all PREMIUM
Router1(config-cmap)#match ip dscp 46
Router1(config)#class-map match-all GOLD
Router1(config-cmap)#match ip dscp 10
Router1(config)#class-map match-all SILVER
Router1(config-cmap)#match ip dscp 22
Router1(config)#class-map match-all BEST-EFFORT
Router1(config-cmap)#match ip dscp 0
```

At Router 1 create the CORE policy map for prioritization, bandwidth guarantee for each class and congestion control:

```
Router1(config)#policy-map EDGE
Router1(config-pmap)#class PREMIUM
Router1(config-pmap)#priority percent 10
Router1(config-pmap)#class GOLD
Router1(config-pmap)#bandwidth percent 20
Router1(config-pmap)#class SILVER
Router1(config-pmap)#bandwidth percent 15
Router1(config-pmap)#class BEST-EFFORT
Router1(config-pmap)#police 512000 100000 100000 conform-action set-dscp-transmit 0
                                     (rate limit of 512Kbps; normal burst of 100Kbytes and maximum burst of 100Kbytes)
```

Apply this policy map in the **output** direction of interface f0/0 of Router1.

Note that this is only an illustrative example of how DiffServ could be configured on a core router.

7. By using the

```
show policy-map <map_name>
```

```
show policy-map interface <interface>
```

```
show interface <interface>
```

commands, monitor and troubleshoot the operation of the DiffServ network.

8. Consider that PC1 and PC2 will have a database synchronization service that must have the lowest delay possible (up to 15% of link bandwidth). The synchronization traffic uses TCP (port 6622) and only the traffic with source in PC1 and destination to PC2 must be allocated to this traffic class.