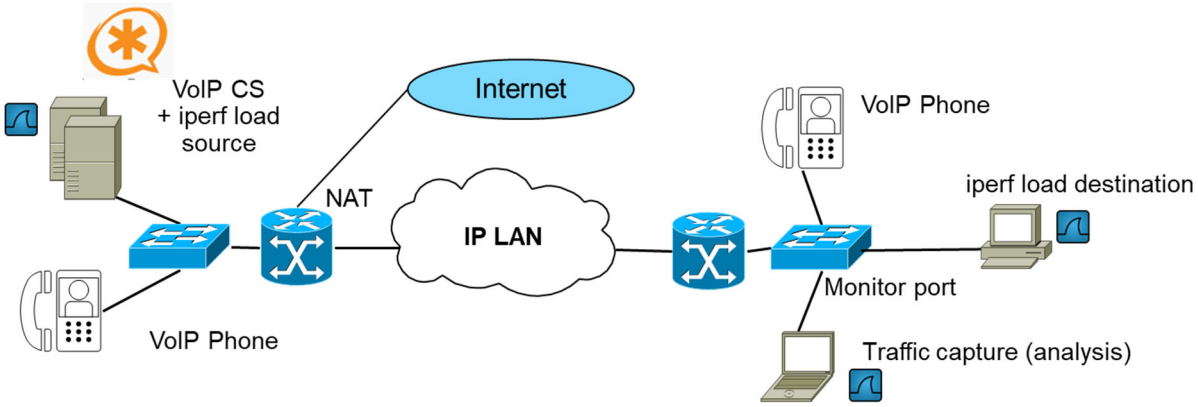
AMC Default Lab

QoS Analysis in VoIP Enterprise LAN

Final Topology

Topology

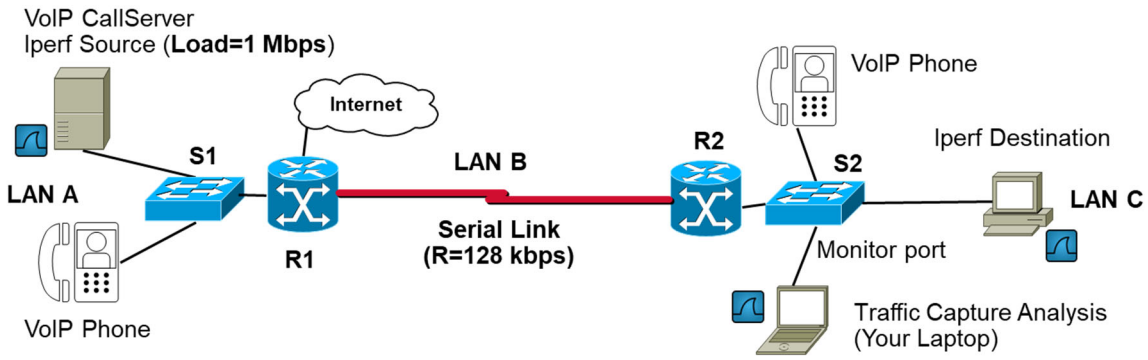
In the end, you will run a VoIP service in an QoS-enabled network with 3 local subnets. In Task1 to 3 you will build up this network step-by-step and you will investigate BE and QoS behavior.



Task 3: DiffvServ Domain Implementation and QoS Traffic Analysis

Topology

Continue with the topology.



Note: Some routers have GigabitEthernet interfaces **G0/0** and **G0/1 (see above)**, and others have Fast Ethernet **F0/0** and **F0/1** interfaces. When you use the **show ip interface brief (sh ip int br)** command, you see which type of interfaces are installed on your router.

Part 1: Optional: Fix some problems and simplify traffic filter tasks

a. Option 1: Monitoring of a 1 Gbps GigabitEthernet port on a 100 Mbps FastEthernet monitoring port may create some additional ripples in the I/O graphs. (Some limited ripples are normal because of buffer emptying.). Change the switch ports to routers to FastEthernet ports at switches. Do not change the router port, it will be set to 100 Mbps by ANP automatically.

b. Option 2: To simplify IP traffic filtering, change the VoIP Service NOT to use peer-to-peer capabilities. Switch-off Asterisk option directmedia or canreinvite. By that all VoIP traffic (signaling and media data) is routed via the Asterisk server.

- `directmedia=no`
- `canreinvite=no (depreciated option)`

Part 2: DiffServ Domain Implementation

Step 1: Service Definition

a. The network shall run 2 network services:

- VoIP (or voice and video) including signaling traffic and media data (sample) traffic. The VoIP service uses a PCM codec for sampling and SIP signaling.
- Best effort service for any other traffic.

b. The VoIP service shall become expedited forwarding (EF) service.

c. Define the mapping of services to DiffServ class name, DSCP class, and DSCP value.

Service	Class name	DSCP class	DSCP value
VOIP (SIP and RTP)	Premium	EF	46
Best Effort	Default	BE	0

Step 2: Traffic matching by ACLs

a. Both routers are ingress routers in your DiffServ Domain. Monitoring is configured in LAN C. Thus any traffic from LAN A to LAN C is interesting for analysis.

b. SIP signaling and RTP media data shall be send and received to and from the Asterisk server.

c. Iperf load will be used to check the QoS behavior and traffic prioritization in the DiffServ Domain.

d. Check in your network setup, which IP addresses and port numbers must be filtered to match the VoIP service and record this information:

IP flow	DSCP	Source Address	Source Port	Destination Address	Destination Port
SIP	46	10.6.0.5	5060	10.6.2.2	5060
RTP	46	10.6.0.5	16384 ... 32767 our ports are lower?	10.6.2.2	50040
iperf	0	10.6.0.5	51115 but changes	10.6.2.3	5001

e. Create an ACL on each router to match VoIP traffic. Record your ACL.

R1 ACL
access-list 101 permit udp any any eq 50040 access-list 102 permit udp any any eq 5060

R2 ACL

```
access-list 101 permit udp any any range 10000 32768
access-list 102 permit udp any any eq 5060
```

f. Create an ACL on both routers to match iperf traffic. Record your ACL.

R1 ACL

```
access-list 103 permit udp any any eq 5001
```

R2 ACL

```
access-list 103 permit udp any eq 5001 any
```

Step 3: Ingress router R1 and R2 class-map and priority-map

a. Create a class-map for R1 to implement a match of IP flows to DiffServ classes. Record your class-map.

R1 class-map

```
class map match-any Premium
  match access-group 101
  match access-group 102
class map match-any Default
  match access-group 103
```

Create a policy-map for R1 to set DSCPs. Record your policy-map.

R1 ingress policy-map

```
policy-map DSCPVALUES
  class Premium
        set ip dscp 46
  class Default
        set ip dscp 0
```

```
service-policy:
ingress: service-policy input DSCPVALUES
egress:  service-policy output VOIP
```

b. Create a class-map for R2 to implement a match of IP flows to DiffServ classes.
Record your class-map.

R2 class-map
class map match-any Premium match access-group 101 match access-group 102 class map match-any Default match access-group 103

Create a policy-map for R2 to set DSCPs. Record your policy-map.

R2 ingress policy-map
policy-map DSCPVALUES class Premium set ip dscp 46 class Default set ip dscp 0

Step 4: QoS scheduling

a. For the VoIP service you must guarantee link layer throughput of one VoIP call plus some additional bandwidth for signaling.

b. We estimate to have 10% of link layer bandwidth for the signaling part. Calculate the required bandwidth for the VoIP service, which must be guaranteed for VoIP.

Service	**Bandwidth (kbps)**
VoIP RTP bandwidth	90
VoIP signaling bandwidth	9
Total required bandwidth	100

For implementation, round up the necessary bandwidth to the nearest full 10 kbps.

c. The VoIP service shall have minimum latency and guaranteed bandwidth for one VoIP call, when VoIP traffic is forwarded on a router link.
Create a policy-map on router R1 for traffic forwarding in the DiffServ Domain.

R1 egress policy-map
policy-map VOIP class PREMIUM priority 100

d. Apply your policy-map on the forwarding serial interfaces.

e. Create a policy-map on router R2 for traffic forwarding in the DiffServ Domain.

R2 egress policy-map
policy-map VOIP class PREMIUM priority 100

f. Apply your policy-map on the forwarding serial interfaces.

Part 3: Analyze QoS Services Effects

Step 1: Analyze QoS Behavior

a. Capture traffic load generation and VoIP call with PCMA codec in parallel and save this Wireshark capture.

- Start the Wireshark capture on your MonitorPC
- Start a load generation of UDP with 1 Mbps bandwidth
- Start the phone call; Stop the phone call; within 10 s
- Stop load generation
- Stop the Wireshark capture after the load generation has ended

Note: Ensure that you do not capture each IP packet more than 1x on your monitor PC.

b. Display and record the throughput in Wireshark I/O-Graph of both network traffic flows:

1.) VoIP call traffic throughput

2.) Iperf load traffic throughput

c. The QoS implementation provides priority for VoIP traffic.
Measure the Data Link Layer throughput of both traffic flows, after this traffic has passed the serial link.

Link Bandwidth (kbps)	**VoIP Traffic Data Link Layer Throughput (kbps)**	**Load Traffic Data Link Layer Throughput (kbps)**
128 kbps	80 - 90 kbps (oscillating)	40-50 kbps (oscillating)

Step 2: Perceptional QoE Impression

a. Repeat traffic load generation and a parallel VoIP call with PCMA codec

b. Describe your perceptional impression, the Quality-of-Experience (QoE), of this phone call.

Codec	PHB Guaranteed Bandwidth (kbps)	QoE Description
PCMA	100	We hear each other perfectly with no latency. SIP is also working perfectly which it did not before. (receiving the call)

Part 4: Final Demonstration

Task3		Approved / Corrections
Period	**04.12. – 16.01.**	
Request an MS3 meeting by Email, in minimum 3 days before your proposed date.		

Part 5: Report Creation

Task4		Approved / Corrections
Period	**07.01. – 20.01.**	
Write a scientific paper about your results, methodology and findings in this lab in IEEE paper format. Deliver your report by Email latest on Jan. 20.		

Part 6: Lab Cleanup

Task5		Approved / Corrections
Deadline	**23.01.**	
Cleanup your workplace latest by Jan. 23.		