# SISTEMAS E REDES MULTISERVIÇO

Practical exercises nº 1 – QoS

1. Over a period of time, a communications network was monitored which revealed that:
   - In 20,000,000 IP packets, 850 of them have not reached their destination;
   - A user has made a series of "ping" commands to the application server and obtained an average response time of 90 ms, a minimum of 65ms and a maximum of 145ms;
   a. Based on the previous data, calculate the loss rate, delay and delay variation of this network.

2. A router has the capacity to process 2048 packets per second (unrealistic estimate; in practice is much higher ☺). At the output buffer entry are the following packets already sorted and placed in three QoS queues (CoS – Class of Service):
   - 512 VoIP packets
   - 1024 email packets
   - 768 internet browsing packets

   a) Calculate how long it would take all VoIP packets to process for each of the following configurations:
      i. FQ
      ii. PQ with prioritization VoIP -> Email-> Internet browsing
      iii. PQ with prioritization Email-> VoIP-> Internet browsing
      iv. WFQ with weights: Email 20%, VoIP 50%, Internet browsing 30%
      v. Using WFQ, what would be the minimum weight assigned to the VoIP queue for all your packets to be processed in less than 250ms?

3. Consider that a telecommunications operator has an IP network with IntServ. This operator has made a contract with a customer that has three geographically distinct LANs according to the following scheme:
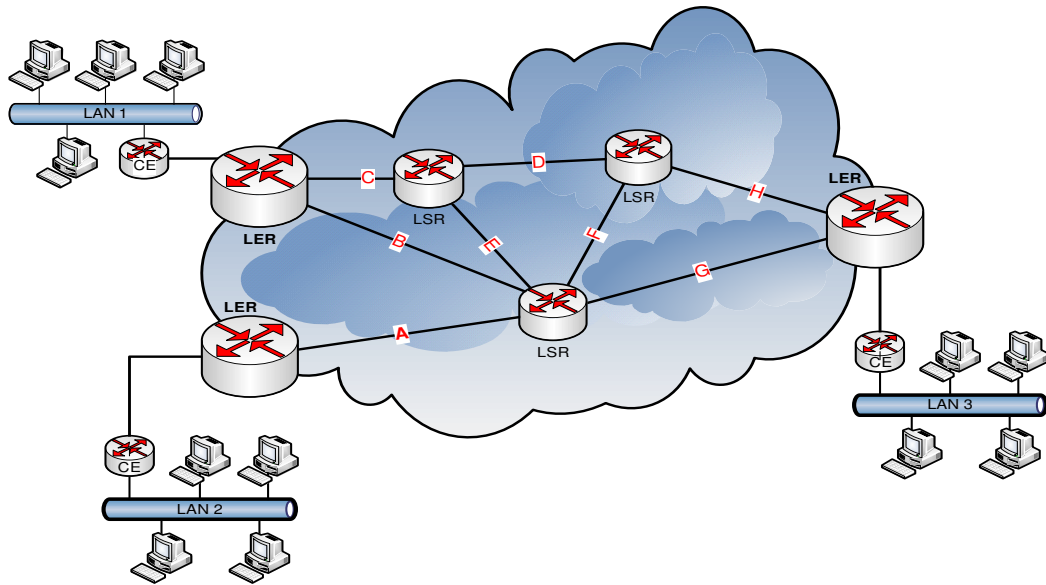
In the contract, the customer made the following requirements in terms of network traffic:

Fluxo	Aplicação	Débito Min	Atraso Máx
LAN1 -> LAN 3	VoIP	480kbps	25 ms
	Base de Dados	1Mbps	50 ms
	E-mail	256kbps	n.a.
	Videovigilância	1Mbps	25 ms
LAN1 -> LAN 2	VoIP	480kbps	25 ms
	Base de Dados	1Mbps	50 ms
	E-mail	256kbps	n.a.

The available capacity on the network and the delay of each link is as follows:

Circuito	Débito Disponível	Atraso
A	2 Mbps	10 ms
B	1,5 Mbps	15 ms
C	1,5 Mbps	5 ms
D	1 Mbps	10 ms
E	512 kbps	5 ms
F	1 Mbps	5 ms
G	2,5 Mbps	10 ms
H	2 Mbps	15 ms

Consider that routing protocols have already established all possible routes between the various routers. Do you think the RSVP protocol will be able to establish all contracted flows? If so, determine the paths in the network for each flow.