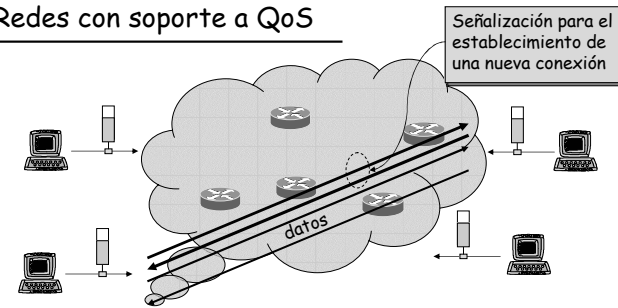


Integrated Services in IP

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Redes con soporte a QoS



Señalización para reserva de recursos (RSVP)
Control de admisión de nuevas conexiones (CAC)
Función de Policía (UPC, ej: TBF)
Políticas de scheduling en los routers (ej: WFQ)

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IntServ

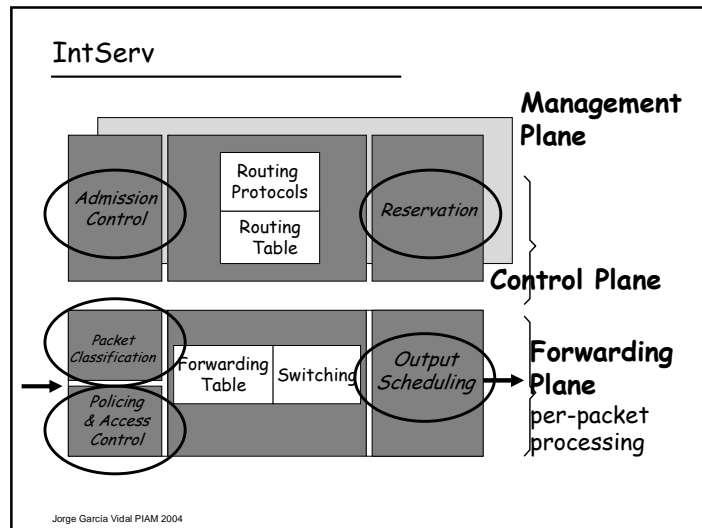
- The goal of the Integrated Services Working Group of IETF is to develop a service model and standard protocols for the Internet that support QoS at *flow* level
- A flow is defined as a one-way stream of data with defined destination/origin (IP@, Port) and Transport protocol
- The model is based on:
 - Using a reservation protocol for resources (RSVP)
 - Using Classes of Services per flow

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IntServ

- An application wishing to obtain a certain QoS:
 - Uses the RSVP signaling protocol for reserving resources in the routers and partners (it supports multicast)
 - The routers will maintain a reservation for a flow (defined as a one-way stream of data with defined destination (IP@, Port, Transport protocol))
 - Routers must implement an Admission Control function for verifying that the resource needed are available.
 - In the new connection is accepted, Routers must thus create and maintain a certain state per each flow
 - When a router receives a packet, classifies it depending on the flow it belongs to and then processes it accordingly

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IntServ: RSVP

- **RSVP**
 - It is a signaling protocol which allows the sender/receiver to reserve resources along a communication path
 - It is used by a host on behalf of an application data flow
 - It provides reservations for bandwidths in multicast trees
 - It is receiver-oriented, i.e. the receiver initiates and maintains the resource reservation used for that flow
 - Note that RSVP does not specify *how* nodes will provide the reservation it requests

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IntServ: Service Types & Classes

- Two types of services:
 - *Guaranteed Service*: Guarantees upper bounds on the communication delay seen by the application
 - *Controlled Load Service*: Guarantees that the performance of the application will not be worse than the performance on an unloaded network.
- The remaining traffic, which does not need RSVP signalling, constitutes the best-effort traffic that is supposed to be delivered at a lower priority than the guaranteed or controlled load services

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IntServ: Service Types & Classes

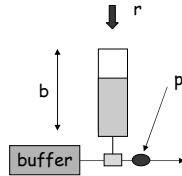
- Las fuentes deben hacer una descripción de las características del tráfico que van a emitir y de la calidad de servicio que esperan obtener de la red:
 - TSpec especifica las características del tráfico. Para fijar los parámetros, se utiliza un Leaky Bucket como referencia.
 - RSpec especifica el nivel de servicio esperado (retardos, pérdidas, etc).

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IntServ: Service Types & Classes

- TSpec:

- peak rate (p , bps),
- burst size (b , b),
- average rate (r , bps),
- Max datagram size (M , b),
- minimum policed unit (m , b).



- $\text{ByteRate}(t) \leq p \cdot t + M$ /* controls peak rate */
- $\text{ByteRate}(t) \leq r \cdot t + b$ /* controls mean rate */
- If a packet have less than m bits, it is counted off to become m

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IntServ: Service Types & Classes

- RSpec

- Minimum Bandwidth: minimum amount of bandwidth required for a flow
- Delay: average or maximum allowed delay
- Delay jitter: maximum difference among max and min delay
- Loss rate

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IntServ: Service Types & Classes

- Guaranteed Service

- This service is intended for applications which require the highest assurance on bandwidth and delay.
- The path that supports *GS* can be viewed as a virtual circuit with guaranteed bandwidth.
- *GS* also provides strict delay bounds, fixing a maximum queuing delay, assuming that the incoming traffic conforms with some specified Token Bucket parameters (i.e P&G result).

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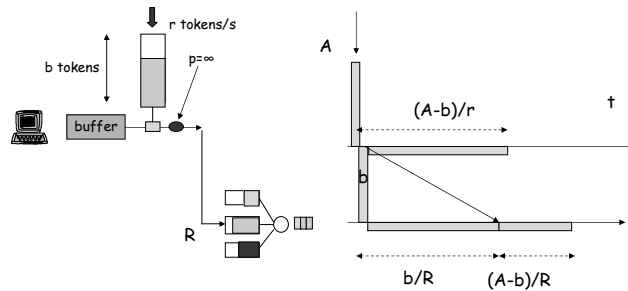
IntServ: Service Types & Classes

- The Tspec use the Token Bucket parameters described before (r , b , p , etc)
- RSpec use two parameters:
 - Service Rate (R , B/s): The bandwidth requirement
 - Slack Term (S , μs): Extra amount of delay a node can add still meeting end-to-end delay requirements. Explained later.

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IntServ: Service Types & Classes

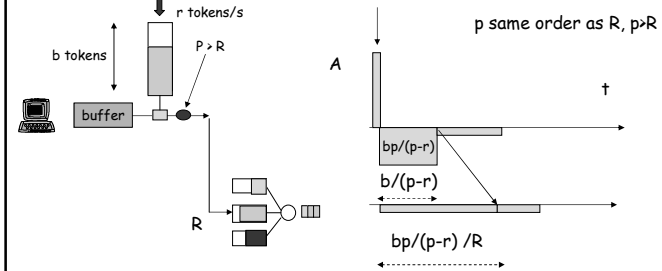
- Delay bounds: For $p \rightarrow \infty$ and $R \geq r$, P&G results gives:
 - Queuing delay $< b/R$.



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IntServ: Service Types & Classes

- If p is of the same order as R and r , with $p > R < r$:
 - Queuing delay $< b/(p-r) \times (p/R - 1) = b/R \times (p-R)/(p-r)$



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IntServ: Service Types & Classes

- Routers introduce additional latency, C_i and D_i .
- C accounts for the transmission delay and D for fixed latency. Defining $C_{tot} = \sum_i C_i$ and $D_{tot} = \sum_i D_i$, the total queuing delay (QD) can be shown to be:
- If $p > R > r$

$$QD \leq (b-M)(p-R)/[R(p-r)] + (M+C_{tot})/R + D_{tot}$$

- If $R > p > r$, there is no queuing delay. Then:

$$QD \leq (M+C_{tot})/R + D_{tot}$$

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IntServ: Service Types & Classes

- **Controlled Rate**
 - The application should perceive the performance of a not overloaded network.
 - There is not a quantitative measure for this. One can interpret that the reservations should not exceed some fixed percentage of the link bandwidth.
 - A very high percentage of transmitted packets will be successfully delivered by the network
 - The transit delay experienced by a very high percentage of delivered packets will not greatly exceed the minimum

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IntServ: Service Types & Classes

- In Controlled Load services, we only specify the Tspec using the Token Bucket parameters described before (r, b, p, etc)