CSE561 – Quality of Service II

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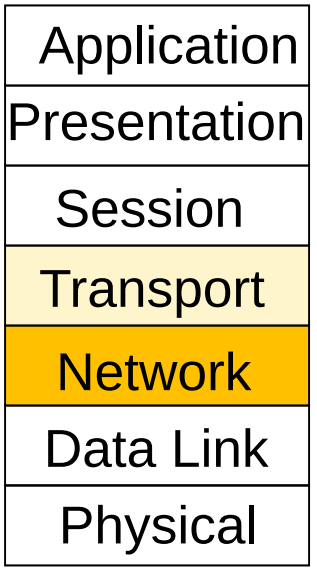
QOS I (IntServ and DiffServ)

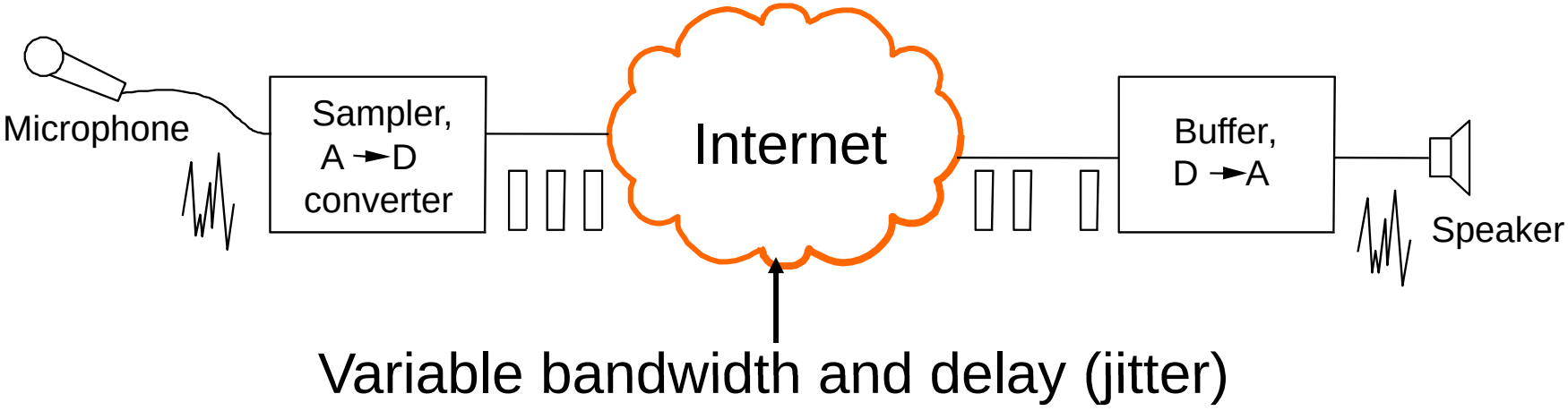
- Focus:
  - How to provide “better than best effort”

- GPS guarantees
- Diffserv
- IntServ



An Audio Example

- Playback is a real-time service in the sense that the audio must be received by a deadline to be useful

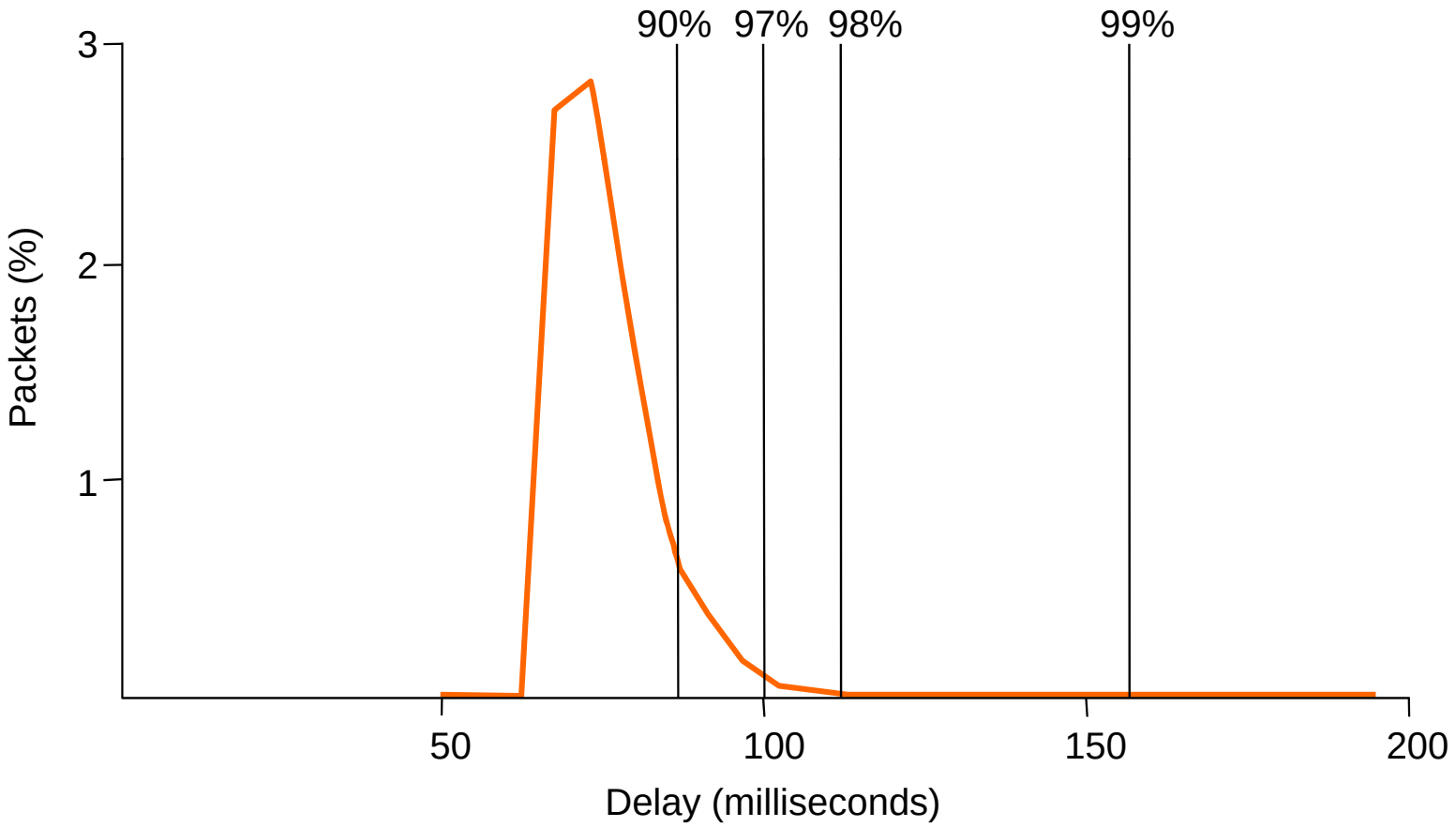


- Real-time apps need assurances from the network
- Q: What assurances does playback require?

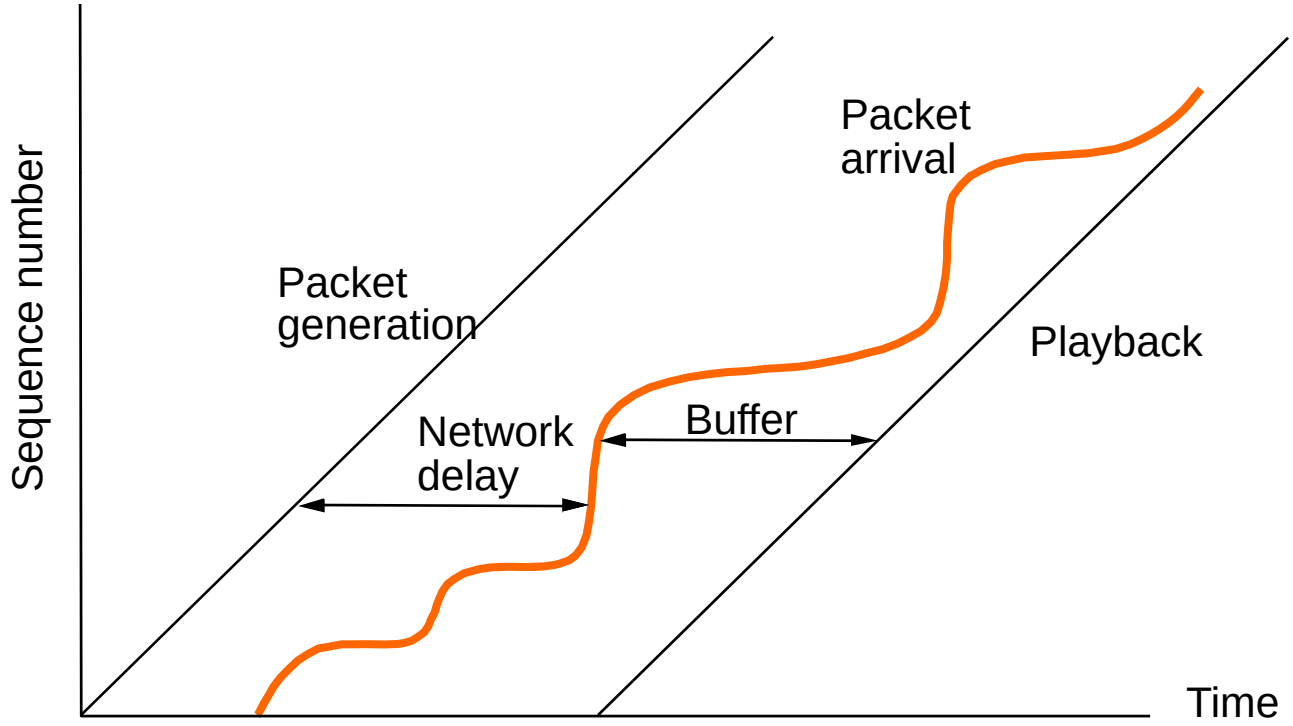
Network Support for Playback

- Bandwidth
  - There must be enough on average
  - But we can tolerate to short term fluctuations
- Delay
  - Ideally it would be fixed
  - But we can tolerate some variation (jitter)
- Loss
  - Ideally there would be none
  - But we can tolerate some losses

Example: Delay and Jitter



Tolerating Jitter with Buffering



- Buffer before playout so that most late samples will have arrived

GPS Result (Parekh & Gallagher 92)

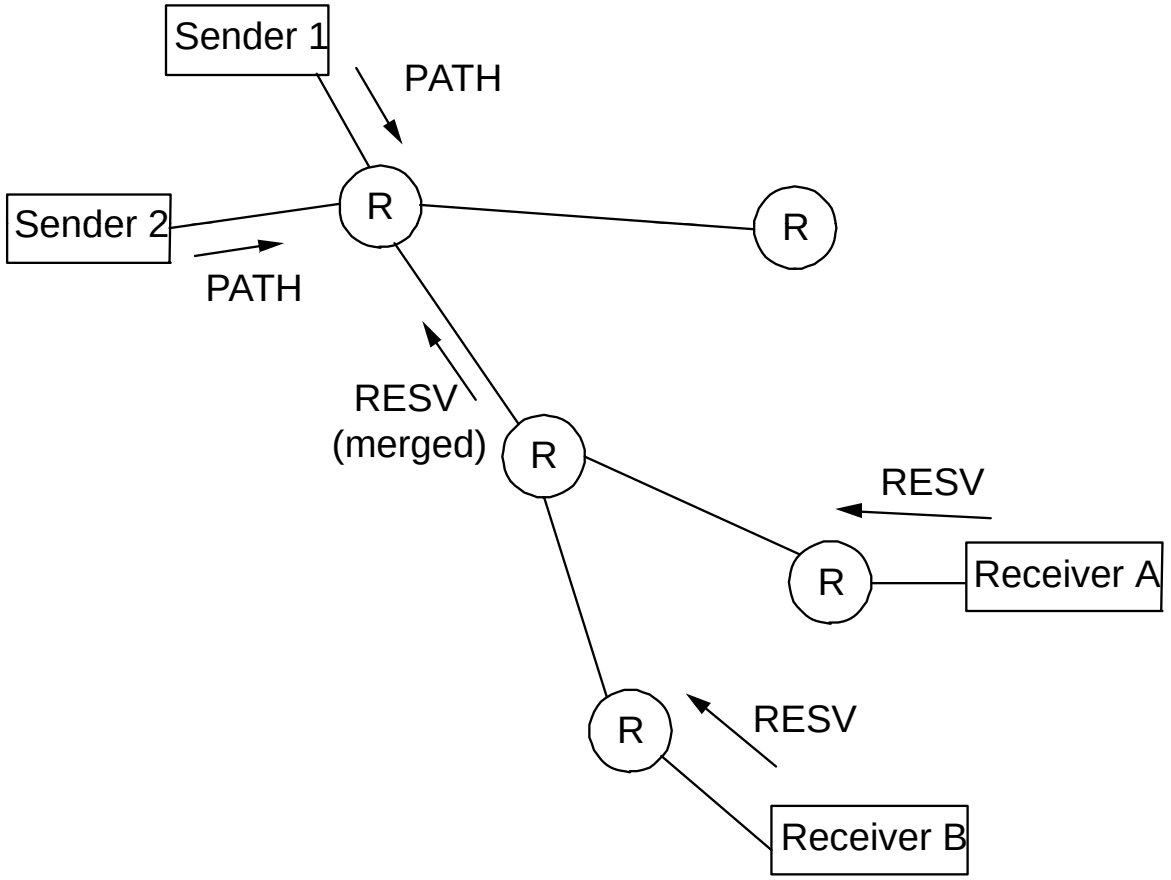
- Condition a traffic source with R,B token bucket
- Assign weight for the flow at each WFQ router on the path to be >R/link capacity of the total weight
- Use any network topology you like!
- Do what you like with other traffic!

- Result (simplified):
  - Flow is guaranteed a bandwidth of R
  - Flow is guaranteed a delay of the path latency + B/R

IETF Integrated Services

- Fine-grained (per flow) guarantees
  - Guaranteed service (bandwidth and bounded delay)
  - Controlled load (bandwidth but variable delay)
- RSVP used to reserve resources at routers
  - Receiver-based signaling that handles failures
- WFQ used to implement guarantees
  - Router classifies packets into a flow as they arrive
  - Packets are scheduled using the flow's resources

Resource Reservation Protocol (RSVP)



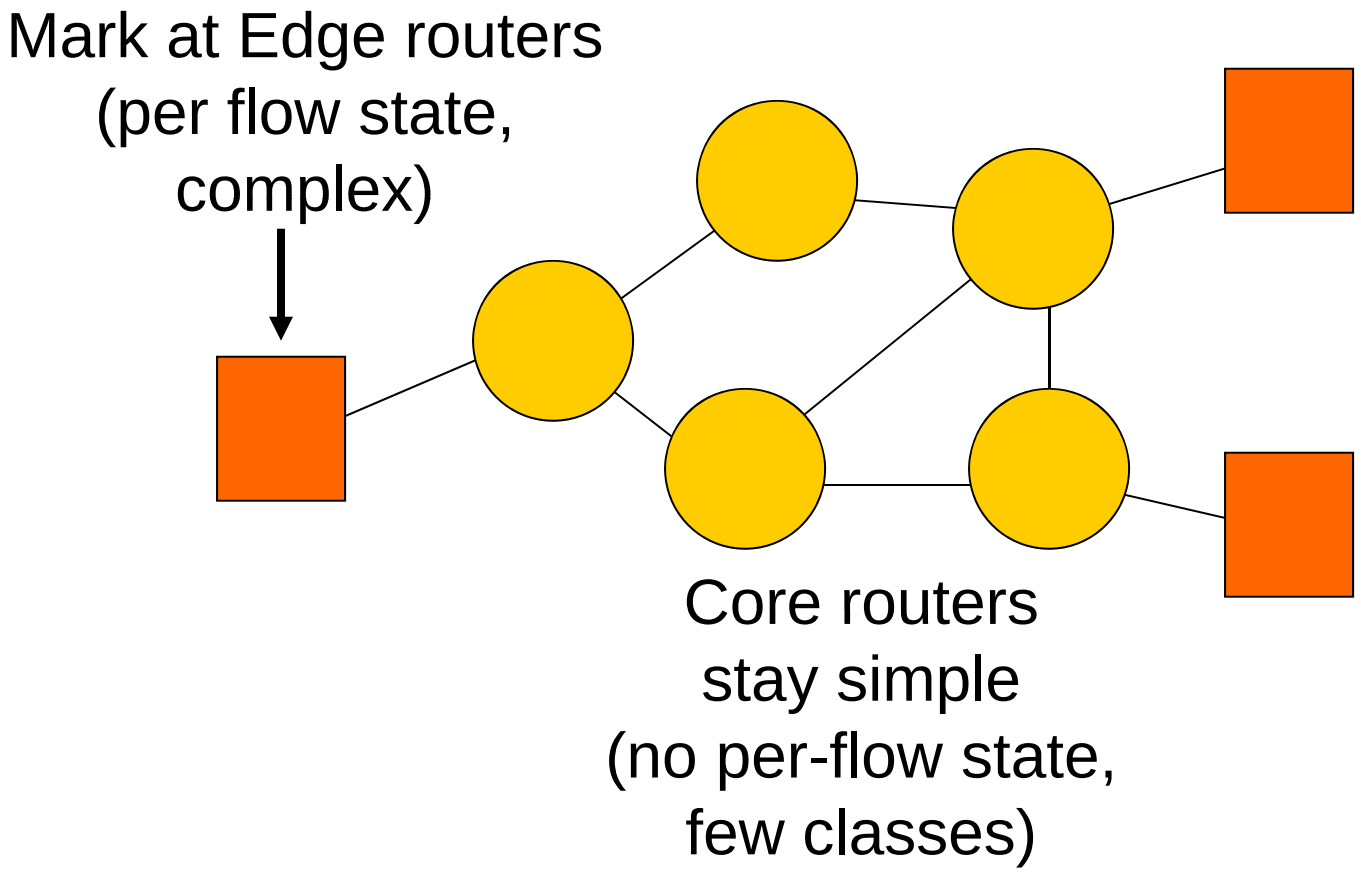
RSVP Issues

- RSVP is receiver-based to support multicast apps
- Only want to reserve resources at a router if they are sufficient along the entire path
- What if there are link failures and the route changes?
- What if there are sender/receiver failures?

IETF Differentiated Services

- A more coarse-grained approach to QOS
  - Packets are marked as belonging to a small set of services, e.g, premium or best-effort, using the TOS bits in the IP header
- This marking is policed at administrative boundaries
  - Your ISP marks 10Mbps (say) of your traffic as premium depending on your service level agreement (SLAs)
  - SLAs change infrequently; much less dynamic than Intserv
- Routers understand only the different service classes
  - Might separate classes with WFQ, but not separate flows

Two-Tiered Architecture



QOS in the Internet today

- Is in its infancy
  - Routers have many knobs (performance issues though)
  - Buy economic incentives stifle innovation/deployment
- Customers may get SLAs, e.g., bandwidth, uptime
  - Mostly a provisioning issue for ISPs
  - For well-provisioned, congestion is at the edges, e.g., DSL
  - VPNs are a natural service offering
- Network mostly decoupled from hosts
  - Hosts don't mark packets for QOS
  - But network edge devices may classify, e.g., VoIP vs P2P
  - Point solution at edge, or ISP network can then differentiate