QoS in Best-Effort Networks

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Outline

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Introduction

- Load control: key component for QoS
  - Connection Admission Control
  - Best-Effort
- Good source design: bandwidth can be accordant to each user’s QoS need

Best-Effort Network

- Two objectives:
  - Ensure the available capacity of network is used
  - Maximize the QoS perceived by the users
- Source flow control algorithm
  - TCP in today's Internet
- Link active queue management (AQM)
  - Tail-drop queue

Best-Effort Network (cont'd)

- Seller-Buyer relation
  - Source algorithm as buyer
  - Link AQM as seller
- The price:
  - Demand exceeds supply: price increases
  - Demand below supply: price decreases

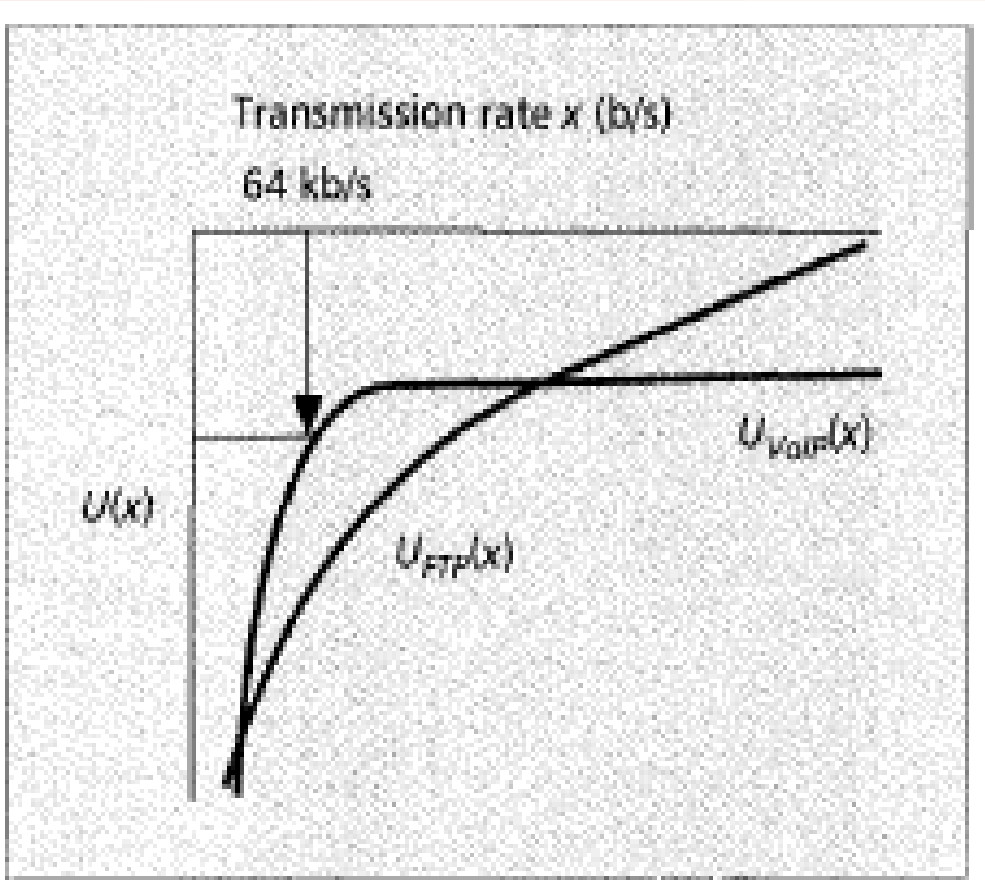
Best-Effort Network (cont'd)

- Feedback mechanism: allows source to learn to send at the capacity of the network available
- Dropping packet: the most common way used for feedback

Utility Function

- Utility function $U(x)$
  - Buyer's function, describes the usefulness a particular transmission rate is to the user
- Net benefit B
  - $B = U(x) - x * c$
  - x : unit of resource
  - c: price per unit

Utility Function (cont'd)



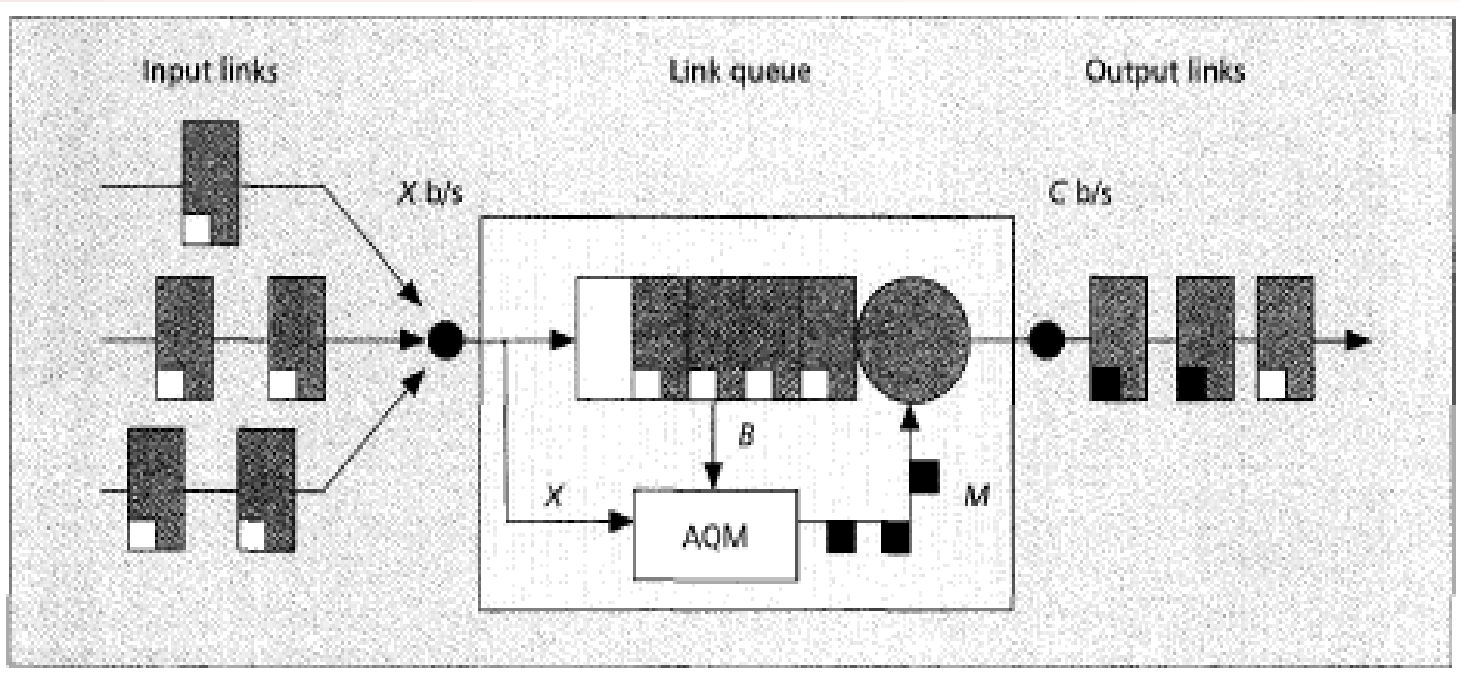
Utility Function (cont'd)

- If each user transmits at a rate that maximizes their own net benefit (B), the supply-demand pricing process will eventually reach a point where the total utility of all users is the maximum possible

Active Queue Management (AQM)

- Tail-drop queue is practically the only AQM on today's Internet
- Backlog-based
- No congestion is detected until the queue is full
- Cycles of decrease and increase that degrade the network performance

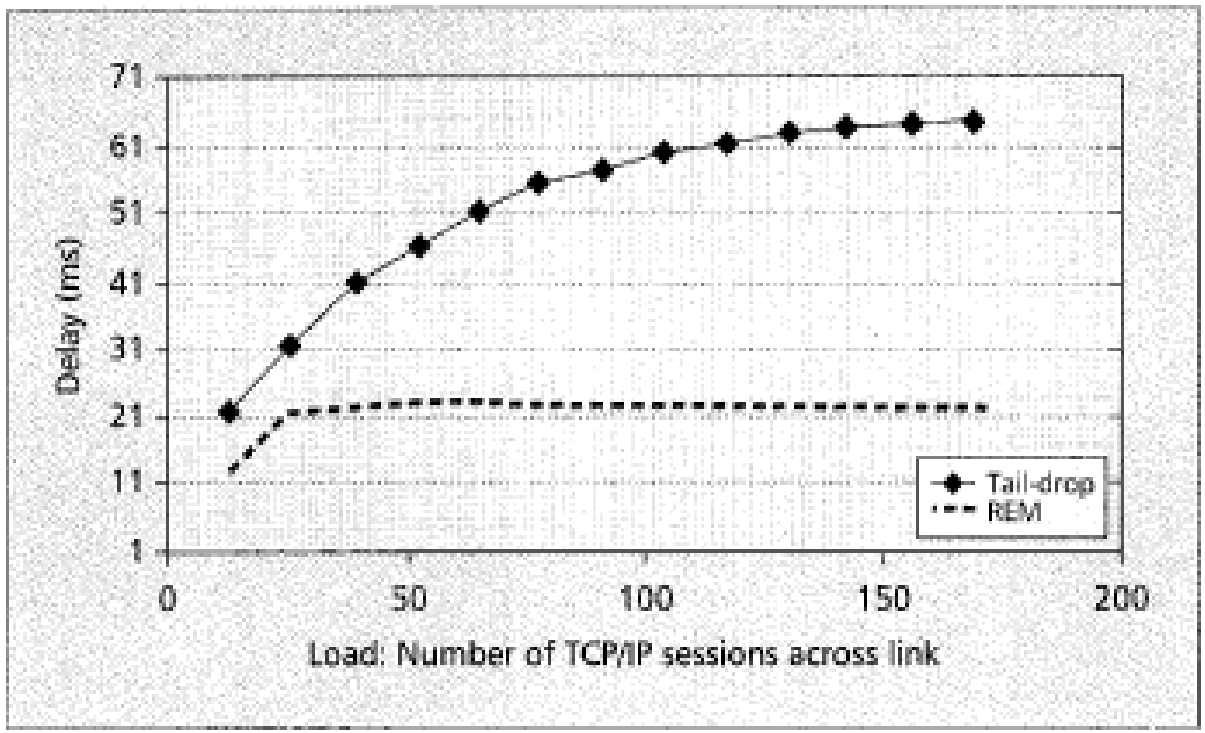
Active Queue Management (cont'd)



Random Early Marking (REM)

- Rate-based
  - Uses arrival rate to determine the congestion level
- Make use of Explicit Congestion Notification (ECN)
- ECN: instead of dropping packets, packets are marked by setting a bit in the packet header

Random Early Marking (cont'd)



Random Early Marking (cont'd)

- While the Tail-drop AQM can't generate the appropriate feedback signal unless the queue is full, REM can measure the bandwidth demand before the queue is full

Accounting

- Use the amount of ECN market packets received by the users to charge
- More bits the user transmits, higher the charge
- When there is heavy congestion, users are charged more

Conclusion

- Deployment of modern AQM in switches and routers will improve the delay performance of network applications, especially the multimedia and interactive ones
- User charging policy would motivate users to regulate traffic to improve network QoS