

CS 414 – Multimedia Systems Design  
Lecture 18 –  
Multimedia Transport  
Subsystem (Part 5)

Klara Nahrstedt  
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# Administrative

## ■ Homework 1

- deadline – February 29
- solutions will be posted on March 1

## ■ Midterm

- March 3 (Monday), 11-11:50am, 1103 SC
- Class Notes + Chapters to read/study:
  - Media Coding and Content processing book
    - Chapter 2, chapter 3.1-3.2, 3.8, chapter 4.1-4.2.2, 4.3, 4.5, chapter 5, chapter 7.1-7.5, 7.7
  - Multimedia Systems
    - Chapter 2



# Outline

## ■ Establishment Phase

- Negotiation, Translation (Monday, 2/18)
- Admission, Reservation (Wednesday, 2/20)

## ■ Transmission Phase

- Traffic Shaping (Wednesday, 2/20)
  - Isochronous Traffic Shaping (Friday, 2/22)
  - Shaping Bursty Traffic (Friday, 2/22)
- Rate Control (Friday, 2/25)
- Error Control (Monday, 2/25)



# Performance Guarantees

- Every traffic management needs QUEUE MANAGEMENT (QM)
- Statistical versus Deterministic Guarantees
- Conservation of Work
  - QM schemes differentiate if they are work conserving or not
  - **Work conserving system** – sends packet once the server has completed service (examples – FIFO, LIFO)
  - **Non-work conserving scheme** – server waits random amount of time before serving the next packet in queue, even if packets are waiting in the queue

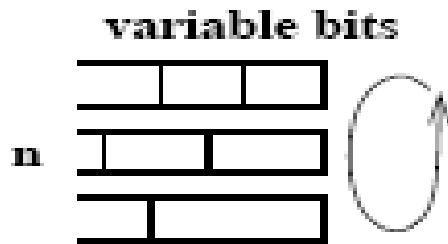


# Rate Control

- Multimedia networks use **rate-based mechanisms** (conventional networks use window-based flow control and FIFO)

Work-conserving schemes	Non-work-conserving schemes
Fair Queuing	Jitter Earliest-Due-Date
Virtual Clock	Stop-and-Go
Delay Earliest-Due-Data	Hierarchical Round-Robin

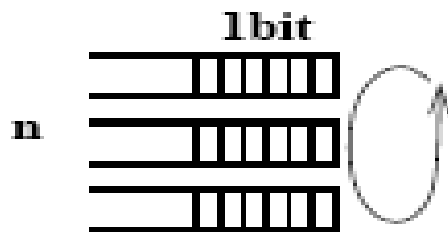
# Weighted Fair Queuing



**Nagle's solution 1987**

**isolation for misbehaved customers**

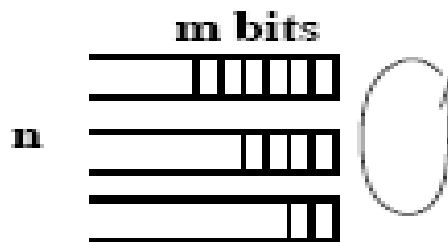
**Limitations: 1. ignored packet length  
2. sensitive to pattern of packet arrival**



**Demers, Keshav, Shenker 1990**

**Fair queueing wait  $(n-1)$  bits times before sending**

**Limitations: give every host the same fraction  
of bandwidth**



**Weighted Fair queueing  $m > n$**

**(m-bits cycles)**

**Parekh's Thesis 1992 - proof of strong  
performance guarantees**



# Comparison between WFQ and Jitter Control

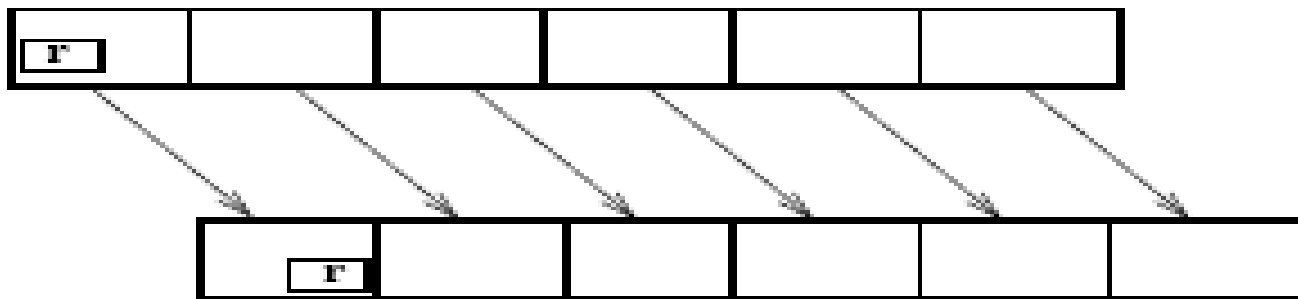
- WFG guarantees packet delay less than a given value  $D$ , but as long as delay is within bound it does not guarantee what the delay will be
- Example: send packet at time  $t_0$  over a path whose minimum delay is  $d$ 
  - WFQ guarantees that packet arrives no later than  $t_0+d$ , but packets can arrive any time  $t_0+x$  between  $[t_0+d, t_0+D]$ .
  - $x$  is jitter

# Jitter Control Non-Work-Conserving Schemes

## STOP-AND-GO QUEUEING (Golestani 1990)

used with  $(r, T)$ -smooth traffic shaping

$T$ -bits



## JITTER-EARLIEST DUE-DATE (Verma, 1991)

Jitter EDD gives each hop in the flow's path queueing budget  $b$ .

Each hop computes its jitter bound  $j$ .

At each hop a packet is eligible to be transmitted  $b-j$  time units after packet arrives.



# Error Control

## ■ Error Detection

- Traditional mechanisms: check-summing, PDU sequencing
- Multimedia mechanisms: byte error detection at application PDU, time detection

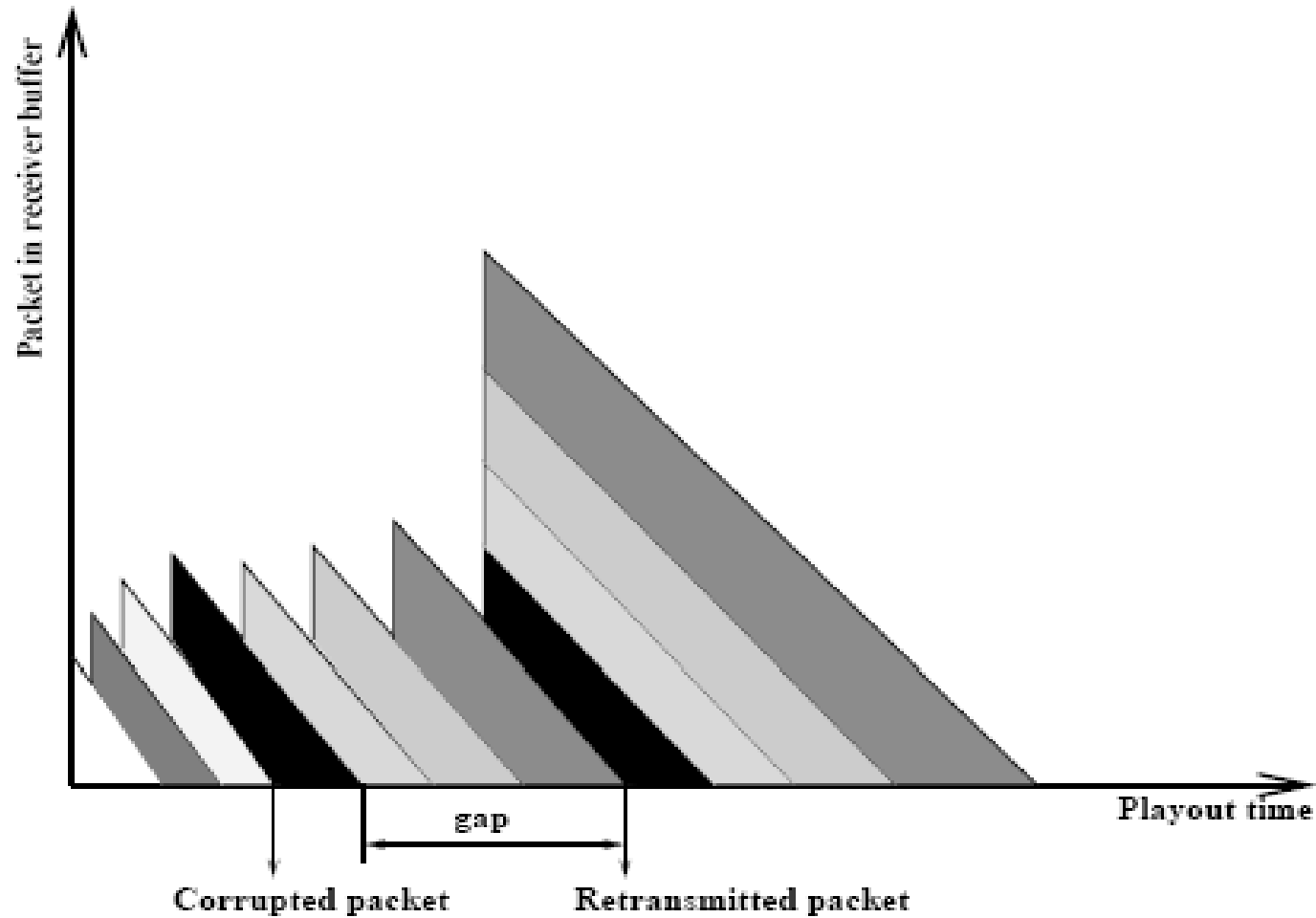


# Error Control

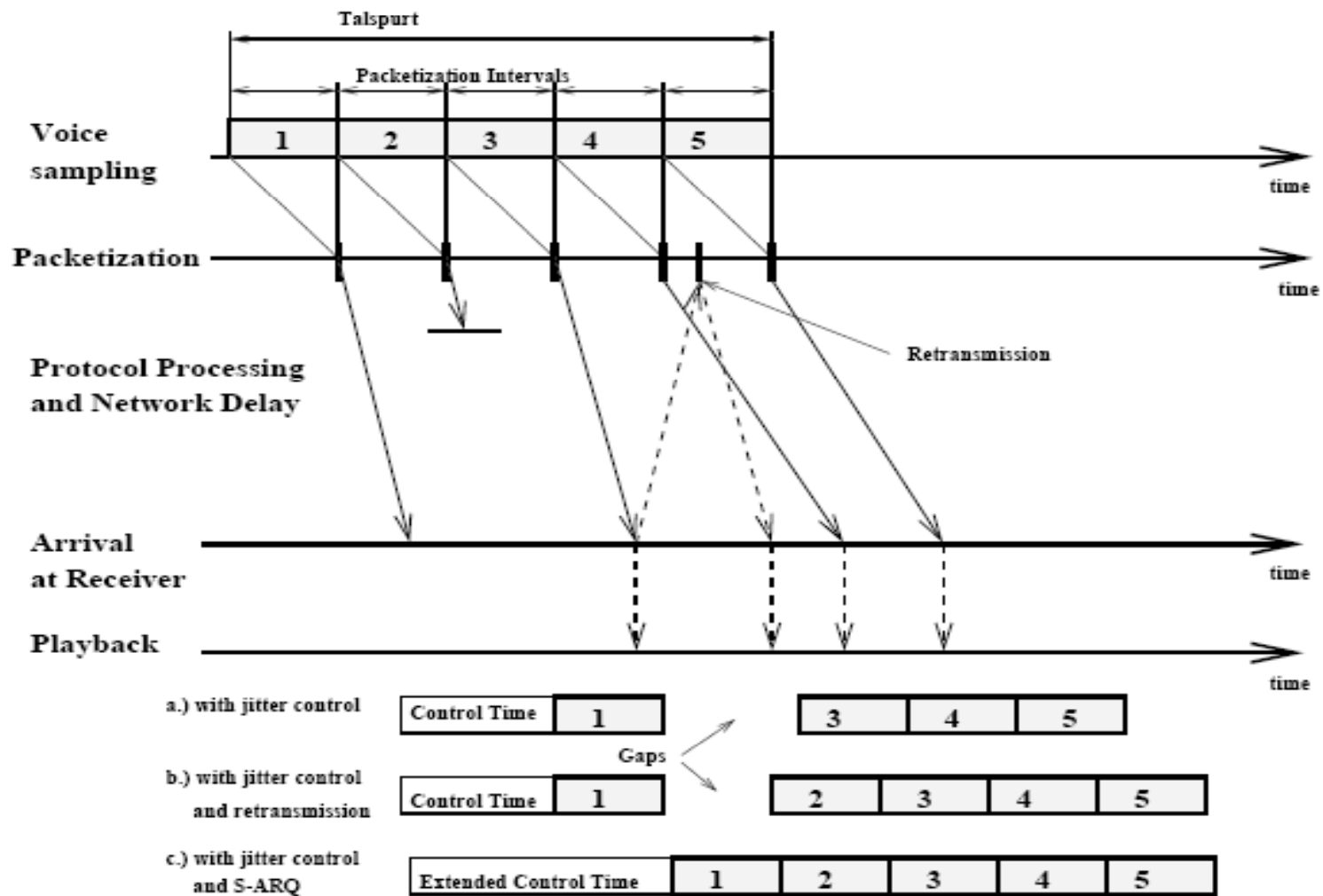
## ■ Error Correction

- Traditional mechanisms: retransmission using acknowledgement schemes, window-based flow control
- Multimedia mechanisms:
  - Go-back-N Retransmission
  - Selective retransmission
  - Partially reliable streams
  - Forward error correction
  - Priority channel coding
  - Slack Automatic Repeat Request

# Go-back-N Retransmission



# Jitter Control in Slack Automatic Repeat Request Scheme





# Conclusion

- Transmission Phase needs traffic management with rate control and error control
- It also needs monitoring and adaptation
  - Network adaptation
  - Source adaptation
    - Feedback from network to source or feedback from out source
    - Adaptive rate control
    - Traffic shaping