CSc 461/561
Multimedia Systems
Multimedia Error Control

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Project Presentation/Demo

Tentatively

- Thursday, April 2
- logistic details to come soon

Project Report/Deliverable

Date fixed

Thursday, April 9

Report format

12-point font, double space, single column

length expectation (all inclusive)

- individual project: 10 pages
- group of 2: 15 pages
- group of 3: 20 pages
- group of 4: 25 pages

What can go wrong?!

- Transmission error
  - depending on transmission media
- Congestion loss
  - due to buffer overflow
- *Excessive* delay
  - packets arriving at receiver “too late”
- Multimedia: error tolerability
  - depending on media type, encoding scheme, etc

How to detect error?

- Cyclic Redundancy Check (CRC)
  - message polynomial: M(x)
  - generator polynomial: G(x)
  - CRC: r(x) = remainder of $M(x)\ x^n$ / G(x)
  - send: $M(x)\ x^n$ - r(x); divisible by G(x)
  - receive M'(x)
  - check whether M'(x) divisible by G(x)
  - e.g., Ethernet FCS (CRC-32)

Error detection: more

- Checksum
  - e.g., IP header checksum, UDP checksum (opt)
    - one's complement of one's complement sum; 16-bit
- Sequence number
  - e.g., RTP sequence number
- Timestamp
  - e.g., RTP timestamp (logic clock)
- Parity bit

* CSC361 TCP/IP checksum

Error correction

- Forward Error Correction
  - adding redundancy at sender
- Retransmission (backward error correction)
  - positive/negative acknowledgment
  - sender/neighborhood, end2end/local retransmit
  - go-back-N, selective retransmission
- Other error handling techniques
  - error concealment

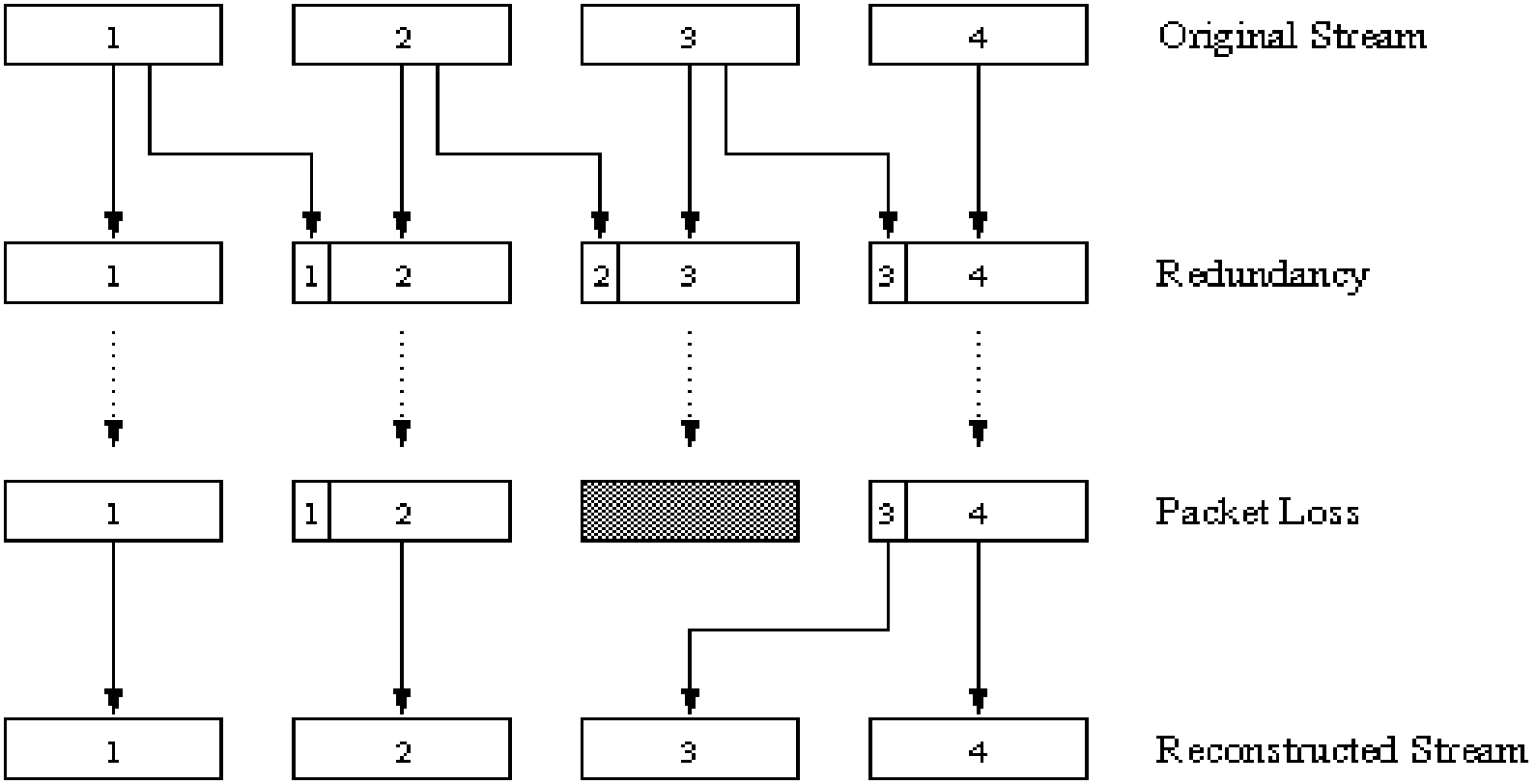
* network-adaptive applications

Forward Error Correction

- Example: parity FEC
  - Packet A, B, and C
  - send A, B, C, and A XOR B XOR C
  - recover A, B, C when any 3 packets received
- Reed-Solomon code: (n,k)
  - over-sampled polynomial; e.g., RS(255, 223)
  - detect error up to (n-k)
  - correct error up to (n-k)/2

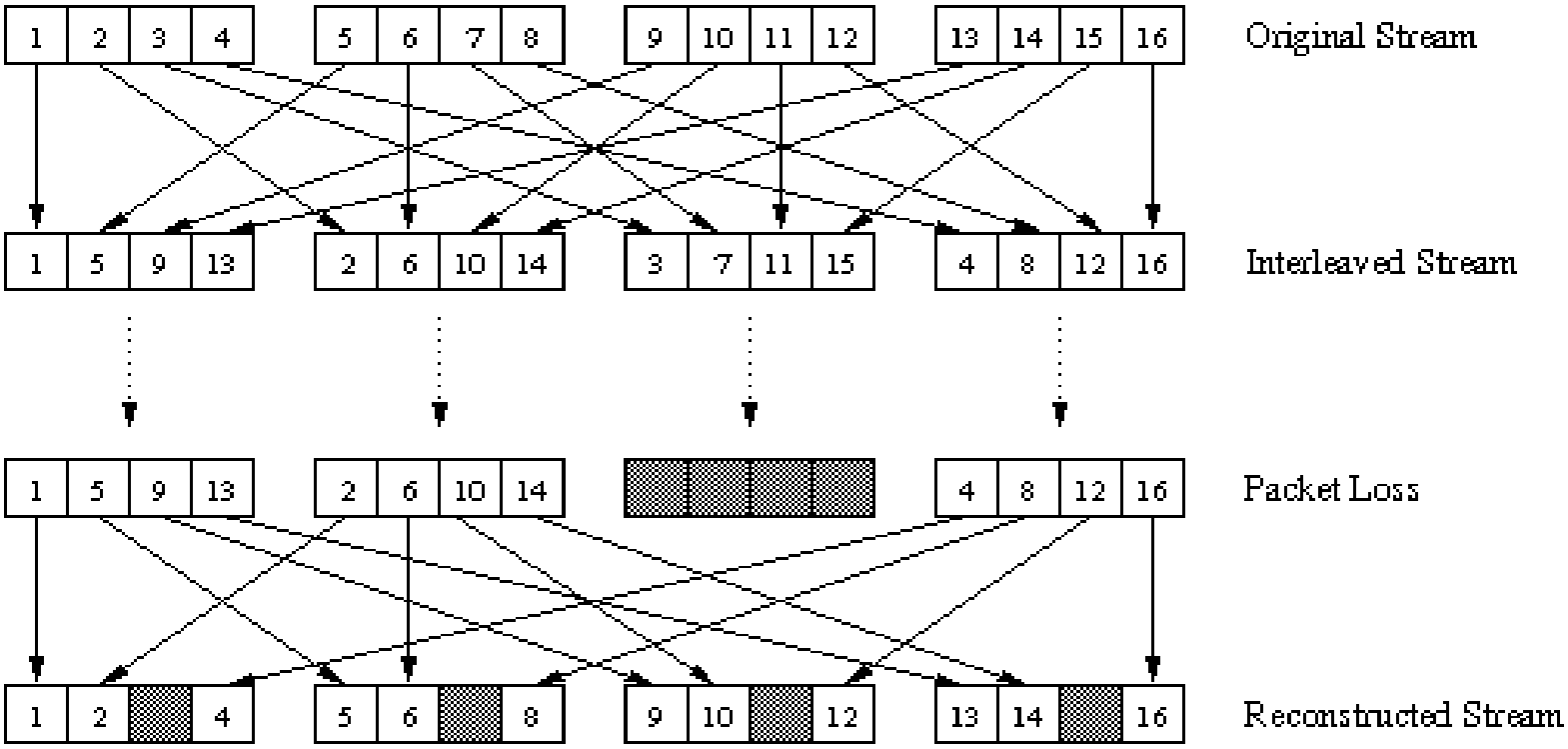
* network coding?

Adding redundancy



* packet length not to scale

Interleaving



* burst vs random errors

Error repair

- Reconstruct missed information at receiver
  - something is better than nothing!
- Error concealment
  - repetition: last sample
  - substitution: white noise
  - interpolation: previous and next sample
- Jitter concealment
  - adaptive playback (delay/jitter estimation)

Error resilience

- Better damage control
  - avoid “from bad to worse”
- Example
  - MPEG: I/P/B-frame
    - the impact of a corrupted I, P, or B frame
- Resilience techniques
  - more important data, better protection
  - update dependency adaptively

This lecture

- Multimedia error control
  - error detection, correction techniques
    - CRC, checksum, FEC, ARQ
  - error concealment, resilience techniques
    - error, jitter, dependency

Next lecture

- Content delivery networks