

CSc 461/561

Multimedia Systems

Multimedia Error Control

Jianping Pan
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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

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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)

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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

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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

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Forward Error Correction

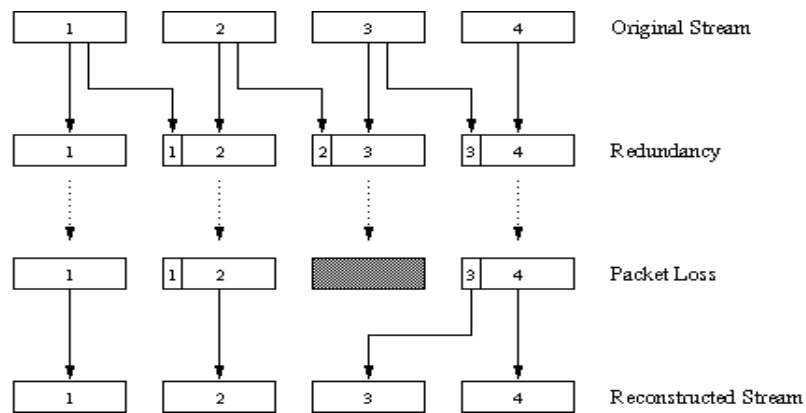
- Example: parity FEC
 - Packet A, B, and C
 - send A, B, C, and A XOR B XOR C
 - recover A, B, C when any 3 packets received
- Reed-Solomon code: (n,k)
 - over-sampled polynomial; e.g., RS(255, 223)
 - detect error up to (n-k)
 - correct error up to (n-k)/2

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Adding redundancy

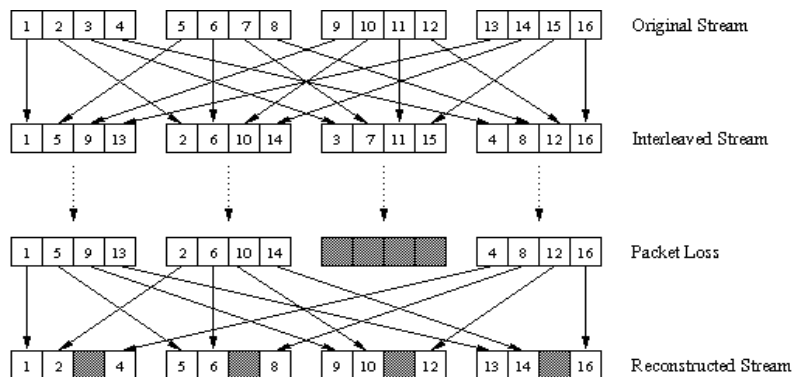


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Interleaving



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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)

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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

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This lecture

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

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Next lecture

- Content delivery networks

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