Error Handling for Video over IP

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Error Handling Approaches

- Retransmission
- Forward Error Correction (FEC)
- Stream redundancy with path separation
- Loss concealment

Retransmission

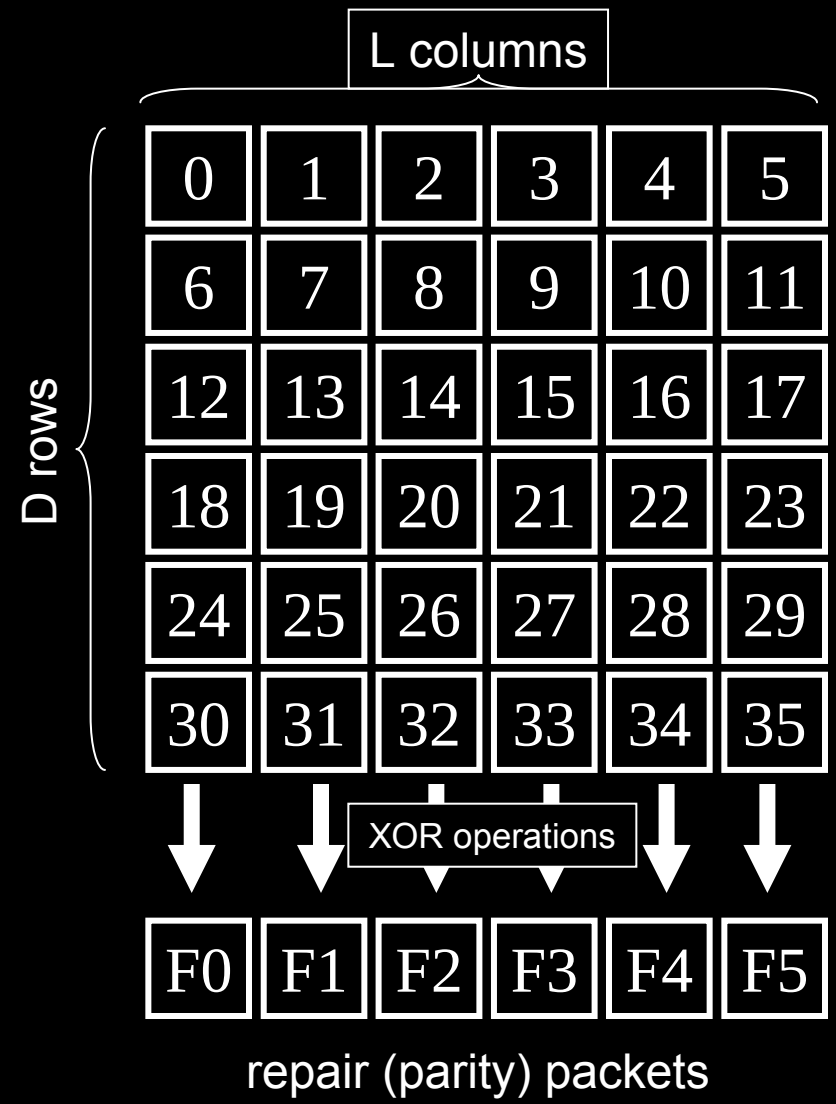
- TCP already has retransmission however it also includes congestion control and packet loss is built into the protocol.
- TCP is not usable for broadcast video but can be used for non-real time transferring of large video content files
- Better alternative for broadcast video is RTP (real time protocol) which has NACK-based retransmission but no congestion control
- Even RTP gets complicated when using multicast video
- Retransmission based recovery would work best on a single point-to-point subscriber link when the transmission delay is small (~10 ms)

Forward Error Correction (FEC)

- Physical layer FEC uses Reed-Solomon or Trellis codes for correcting random errors and short bursts
- Higher level FEC uses packet erasure correction
- Basically sending extra “repair” packets after sending a block of data packets
- Each repair packet contains XOR of a subset of data packets
- Block of data can be recovered if a few more packets than the number of original data packets are received from the combined set
- Extra bandwidth required ~equal to the maximum packet loss to be protected against
- Fixed bandwidth requirement – works well for multicast and unicast
- Can be used to recover from long outages (~200ms) by choosing a larger source block size

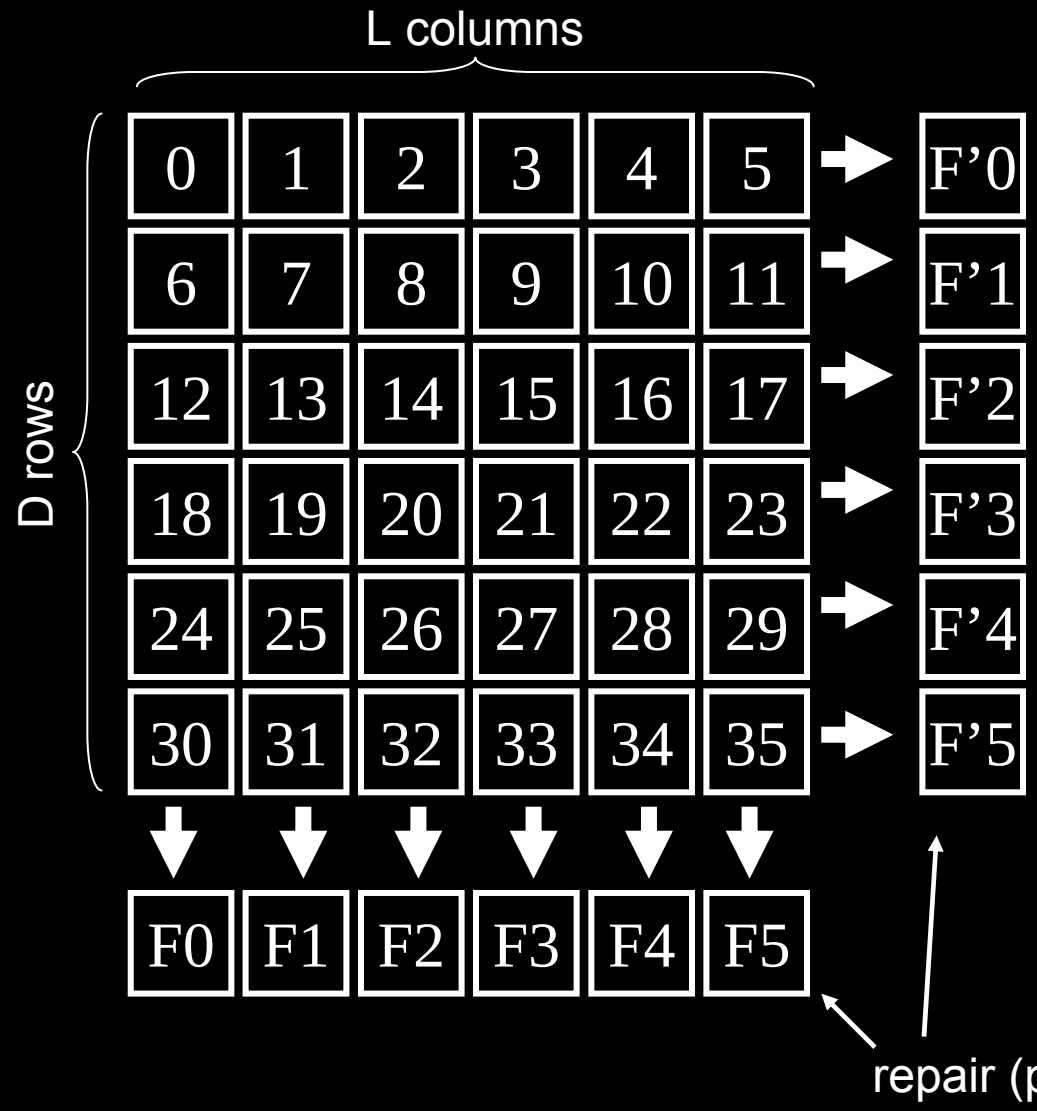
Pro MPEG Forum CoP3 1D FEC

Good For Low Random Loss Due to BER



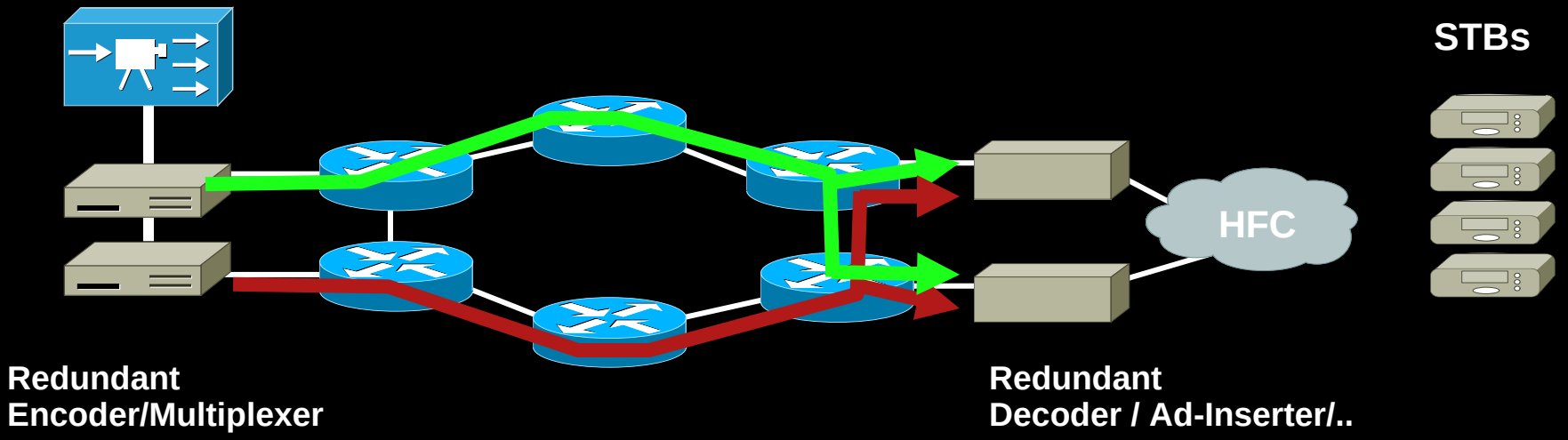
- Source block composed of LxD source packets numbered in sending order
  - $L \times D \leq 100$
  - $1 \leq L \leq 20$
  - $4 \leq D \leq 20$
- Each repair packet is the XOR of the packets in a column
- Overhead = L / (L * D)
- 5% Overhead for L = D = 20

Pro MPEG Forum CoP3 2D FEC
Good For High Random Loss Due to BER



- Source block composed of LxD source packets
- Repair packets calculated across rows as well as columns
- XOR Function Used to create repair Packets
- Overhead = (L + D) / (L * D)

Stream redundancy with path separation



- Send traffic twice to different multicast groups (eg: green = 232.1.0.1, red = 232.1.0.2)
- Use path separation in network to pass red/green across different paths
- Receivers receive both copies, remove duplicates by sequence numbers (eg: MPEG timestamp).
- No single network failure will cause any service interruption
- Same bandwidth allocation needed as in traditional SONET rings, but solution even better: 0 loss instead of 50 msec.

Loss Concealment

- If a single 8X8 block of pixels is lost, the codec can use spatial and temporal averaging of adjacent 8X8 blocks
- MPEG4 Advanced Video Coding can send out two or more streams – base stream plus streams containing details for refinement. If any one stream is available to render a 8X8 block of pixels, something can be shown.
- If all else fails, repeat the last known good frame but this is visible (frame freeze)