

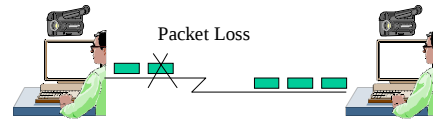
Error Control Techniques for Interactive Low-bit Rate Video Transmission over the Internet.

Injong Rhee

Department of Computer Science

North Carolina State University

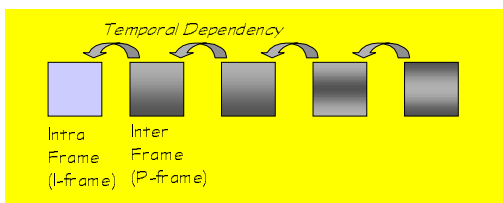
Video Conferencing over Packet-Switching Networks.



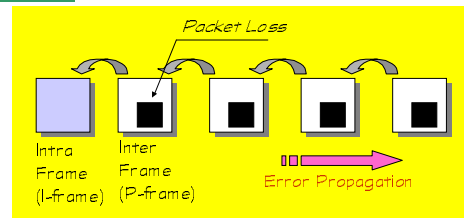
- Compressed video frame is **packetized** and transmitted.
- **Packet loss** can occur quite **frequently** due to congestion and user mobility.

Motion Compensated Coding

- Most video codecs use it.
- Each **P-frame** depends on its **previous frames**.
- **I-frame** is periodically transmitted.

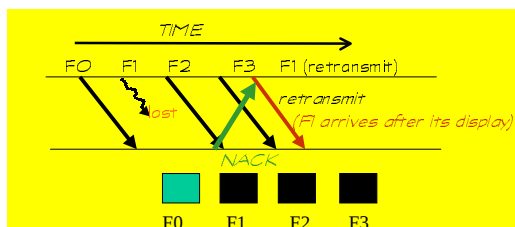


When a packet is lost,....



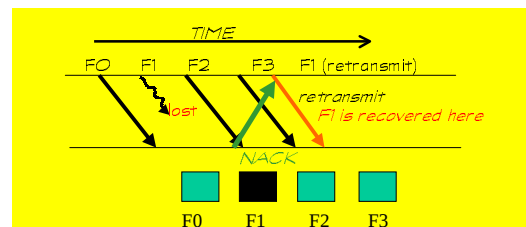
- Conventional Solution : Transmit I-frame more often.
- However, **compression efficiency** reduces.

Myth: retransmission is not useful for interactive video



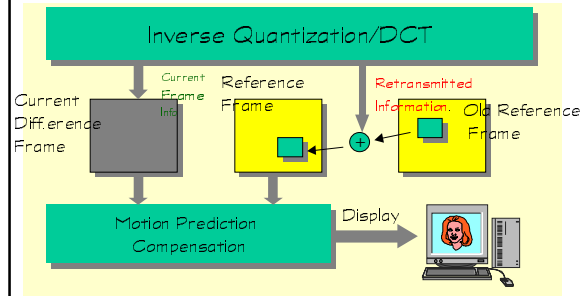
Conventionally, late packets are discarded.

Retransmission stops error propagation.

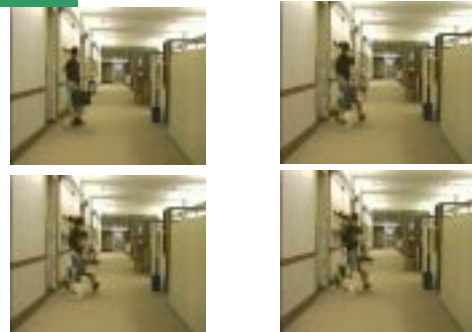


Don't discard: Use late packets to recover their reference frames

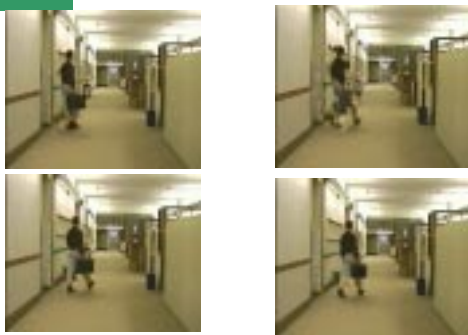
Handling retransmitted 'late' packets in decoder



Error Propagation



Recovery from Error Propagation



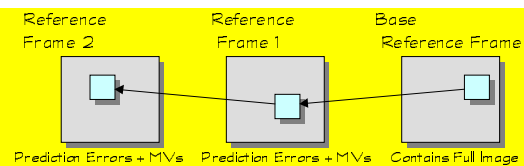
Error Recovery Technique

- Recovery from Error Spread using Continuous Update (**RESCU**)
- Focus on error spread/propagation
- Continuous Update
 - **Retransmission** (this paper)
 - **Forward error correction**
- **Combined with Layer coding** (this paper)

Extending Packet Deadline

- 1 Add more frame buffers at the decoder.
- 2 Adjust Temporal Dependency Distance (TDD) of a frame.
 - TDD: frame intervals from that frame to its temporally dependent frame.

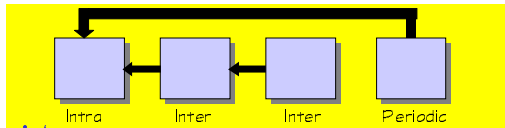
Add more reference frame buffers. Cascaded Buffering



- Minus: More computation and buffers at the decoder.
- Plus: No change in the codec and picture pattern.

Adjust Temporal Dependency Distance Periodic TDDs (PTDD)

- Changing Dependency.

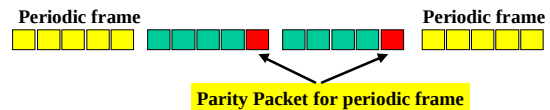


- PTDD can be dynamically adjusted.
- + Reduced Buffers & computations.
- No protection for non-periodic frame.

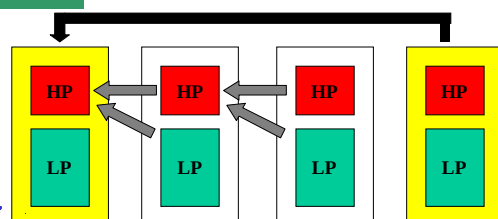
Continuous Updates

Retransmission & Forward Error Correction

- Retransmission
 - Retransmit lost packets within PTDD.
 - Retransmission delay requires larger PTDD.
- Forward Error Correction
 - send parity packets over a PTDD period.



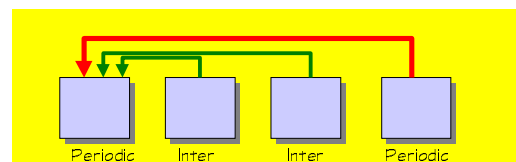
Protecting non-periodic frames RESCU + Quality Assurance Layering



- HP stream is sent with forward error correction.
- RESCU contributes to reducing bit rates.

protecting non-periodic frames

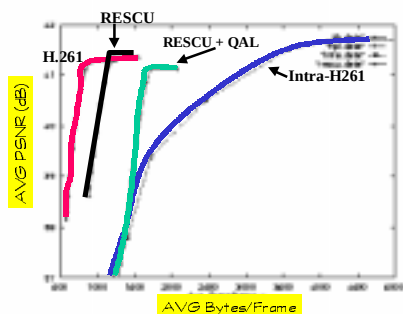
Change temporal dependency



- Errors in non-periodic frames do not propagate.
- As PTDD increases,
 - Compression efficiency decreases.

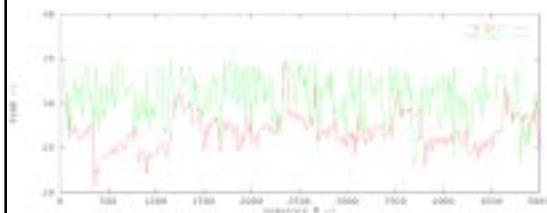
Compression Efficiency

(MPEG-4 Class A, AKIYO)

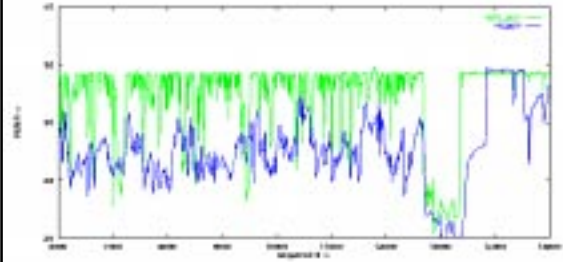


Error Resilience

(H.261 v.s. RESCU)

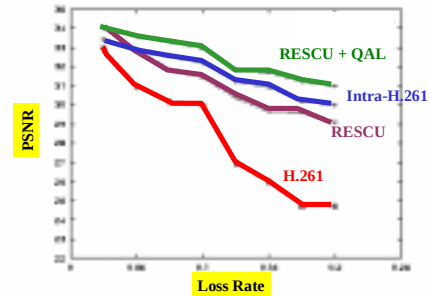


RESCU + QAL



Error Resilience

various loss groups



Conclusions

- RESCU accommodates delays in recovery (retransmission or FEC).
- error resilience for interactive video.
- high compression efficiency.
 - need I-frames less frequently.
- Good for bandwidth-constrained, lossy networks (e.g., mobile wireless networks).
- Much more work to be done.

Error Resilience

Retransmission over various network delays

