

Systematic Lossy Error Protection Versus Layered Coding with Unequal Error Protection

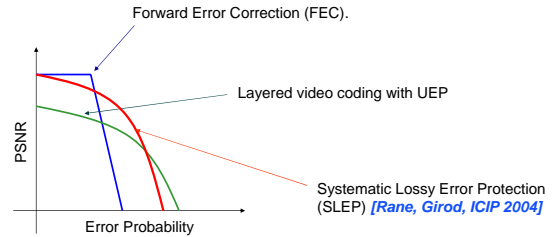


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Limitations of traditional error-resilience methods



How does SLEP compare with Layered Coding in terms of resilience to transmission errors?



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Outline

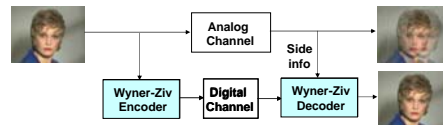
- Systematic source-channel coding
- Systematic Lossy Error Protection (SLEP) using Wyner-Ziv coding
- SLEP versus Layered Coding with Unequal Error Protection



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Systematic Source-Channel Coding



[Shamai, Verdu, Zamir, 1998]

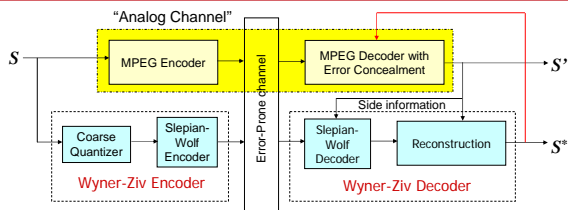
- Enhancing analog transmission systems using digital side information [Pradhan, Ramchandran, 2001]
- Lossy source-channel coding of video waveforms [Aaron, Rane, Girod, 2003]



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Systematic Lossy Error Protection (SLEP)



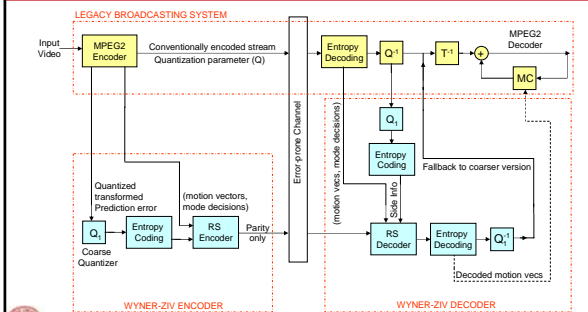
- Analogous to systematic source-channel coding
- Error corrected up to a distortion introduced by coarse WZ quantizer, hence **lossy** protection. [Rane, Aaron, Girod, 2004]



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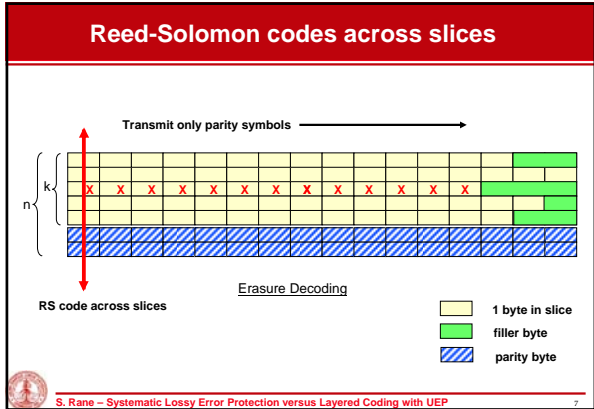
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Practical scheme for Lossy Error Protection



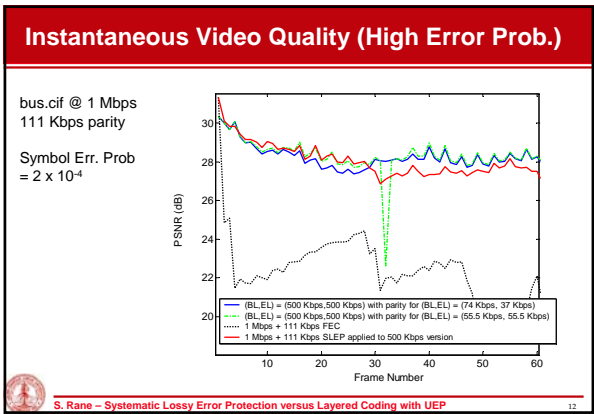
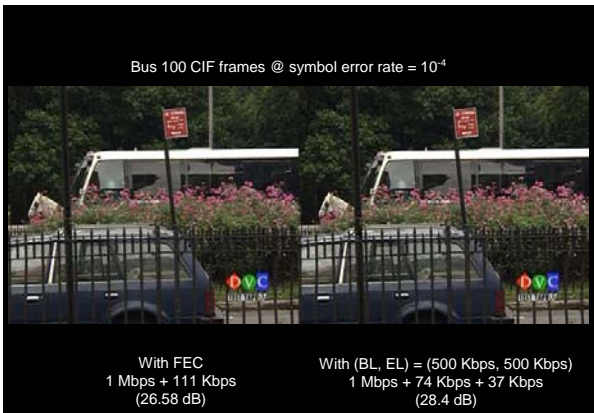
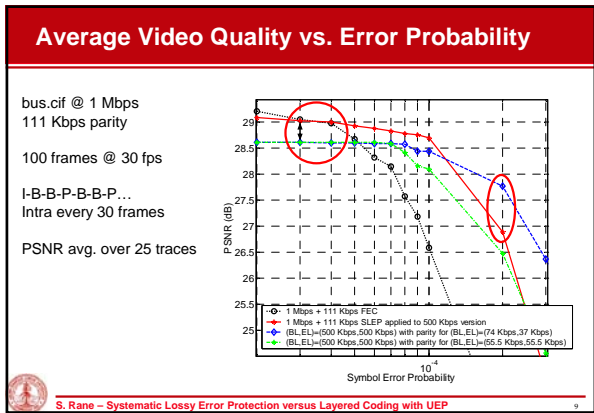
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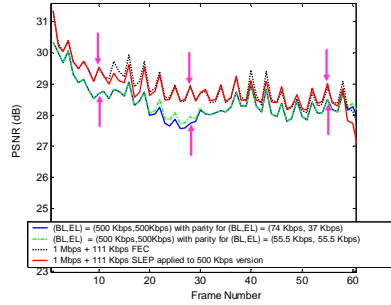
- ### Simulation setup
- SLEP
 - Systematic Transmission → MPEG-2 coded bitstream
 - WZ Codec → Coarse Quantizer + RS Slepian-Wolf codec.
 - Identical slice structure for main and WZ stream
 - Main and WZ descriptions use same motion vectors and mode-decisions
 - MPEG GOP structure : I-B-B-P-B-B-P-...
 - Previous-frame error concealment

 - Layered Coding with Unequal Error Protection
 - Video Codec → 2 layer MPEG-2 SNR scalable video codec.
 - Error protection → RS coding across slices.
 - MPEG GOP structure : I-B-B-P-B-B-P-...
 - Previous-frame error concealment
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Instantaneous Video Quality (Low Error Prob.)

bus.cif @ 1 Mbps
111 Kbps parity
Symbol Err. Prob
 $= 6 \times 10^{-5}$



Conclusions

- ❑ A Wyner-Ziv bitstream provides error-resilience in a systematic source-channel setup.
- ❑ Like layered coding, SLEP provides graceful degradation of video quality over a range of error probabilities
- ❑ Unlike layered coding, SLEP benefits from efficient R-D performance at low error probabilities.

