

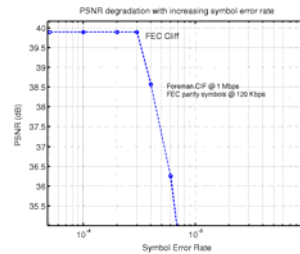
Systematic Lossy Forward Error Protection for Error-Resilient Digital Video Broadcasting



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Limitations of traditional error-resilience methods



- ❑ FEC ("Cliff" effect)
- ❑ Layered Coding with Priority Encoding Transmission (PET) (Inferior R-D Performance) [Albanese et al., 1996]



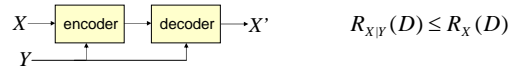
Outline

- ❑ Systematic source-channel coding framework
- ❑ Lossy Forward Error Protection using Wyner-Ziv coding
- ❑ Results and Conclusions

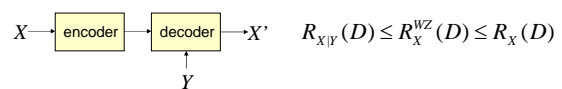


Wyner-Ziv coding background

- ❑ Side-info at encoder and decoder:



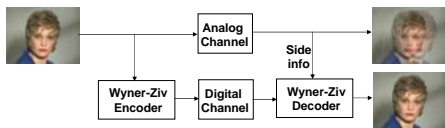
- ❑ Side-info at decoder only: [Wyner and Ziv, 1975-76]



Can achieve bit-rate savings due to correlation between X and Y



Systematic Source-Channel Coding

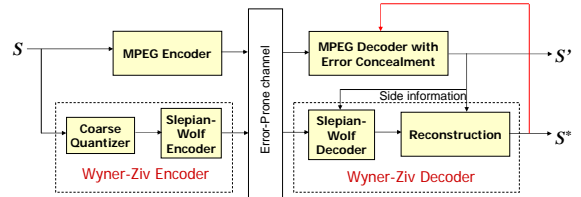


[Shamai, Verdu and Zamir, 1998]

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

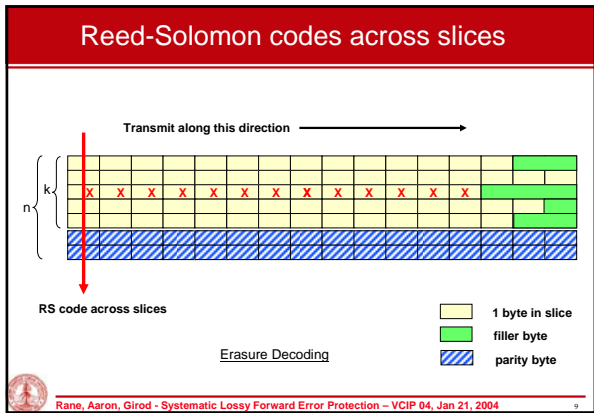
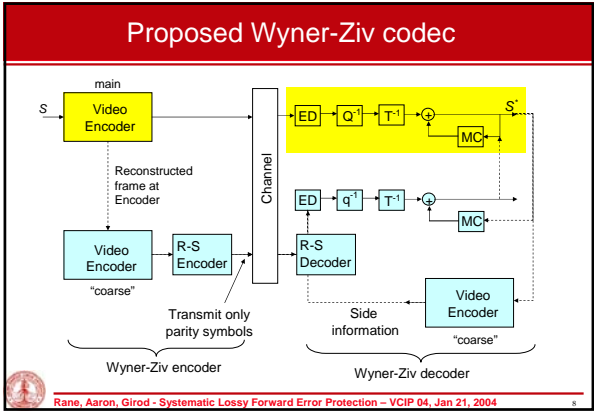
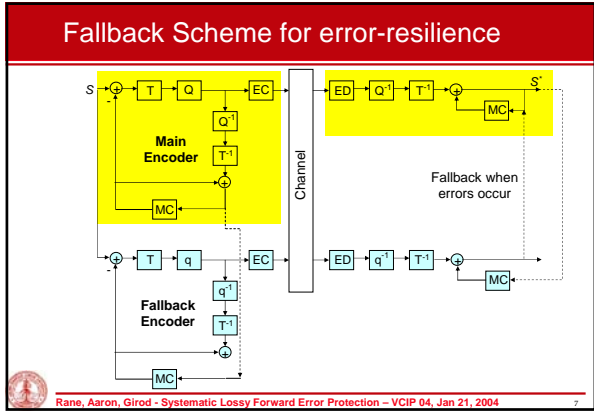


Systematic lossy forward error protection

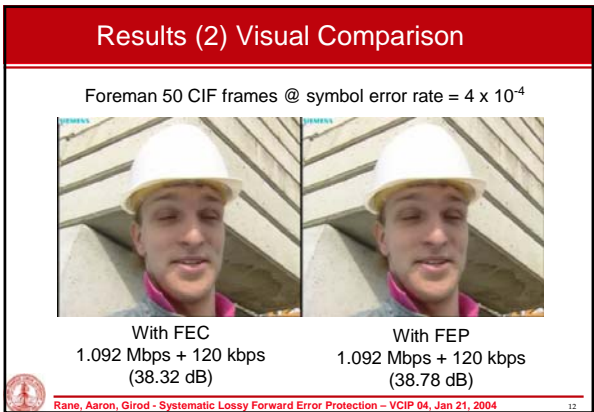
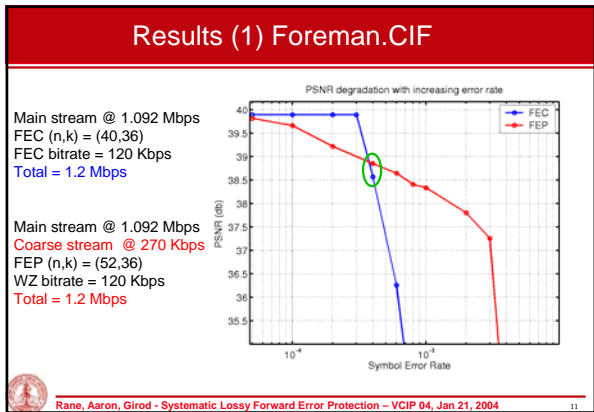


- ❑ Systematic source-channel coding
- ❑ "Lossy" protection
- ❑ Fully backward compatible with legacy systems





- ### Simulation setup
- Codecs:
 - Main Codec → H.26L (JM2.0) codec
 - WZ Codec → H.26L codec and R-S codec.
 - Settings:
 - 1 Slice = 11 macroblocks = 1/2 GOB for CIF frame
 - Identical slice structure for main and WZ stream
- Rane, Aaron, Girod - Systematic Lossy Forward Error Protection - VCIP 04, Jan 21, 2004



Results (3) Visual Comparison

Foreman 50 CIF frames @ symbol error rate = 10^{-3}



With FEC
1.092 Mbps + 120 kbps
(33.03 dB)

With FEP
1.092 Mbps + 120 kbps
(38.40 dB)



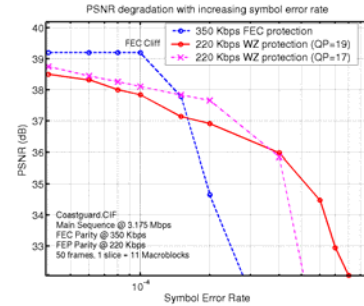
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Results (2) Coastguard.CIF

Main stream @ 3.175 Mbps
FEC (n,k) = (40,36)
FEC bitrate = 352.78 Kbps
Total = 3.5 Mbps

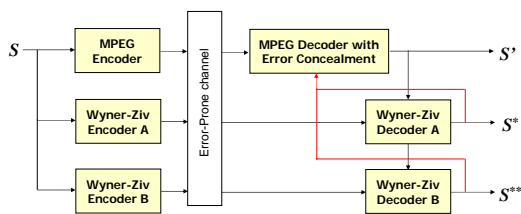
Main stream @ 3.175 Mbps
Coarse stream @ 1 Mbps
FEP (n,k) = (44,36)
WZ bitrate = 220 Kbps
Total = 3.4 Mbps

Main stream @ 3.175 Mbps
Coarse stream @ 658 Kbps
FEP (n,k) = (48,36)
WZ bitrate = 220 Kbps
Total = 3.4 Mbps



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Ongoing Work : Embedded WZ codec



- Graceful degradation of video quality
- Does not require layered representation of original video signal



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Conclusions

- Systematic lossy forward error protection scheme for error-resilient digital video broadcasting
- Outperforms conventional FEC schemes, when SER increases
- Fully backward compatible with legacy broadcast systems
- Can construct embedded Wyner-Ziv codec which achieves graceful degradation without layered representation.



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