# Systematic Lossy Error Protection based on H.264/AVC Redundant Slices and FMO

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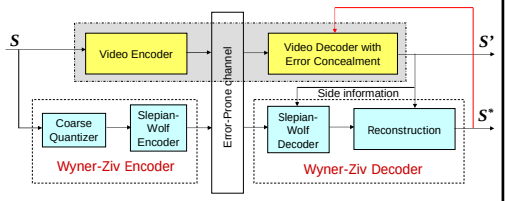
## Outline

- Systematic Lossy Error Protection
- H.264/AVC implementation
- ROI-enhancement for low-motion sequences
- Simulation results



## Systematic Lossy Error Protection (1/5)

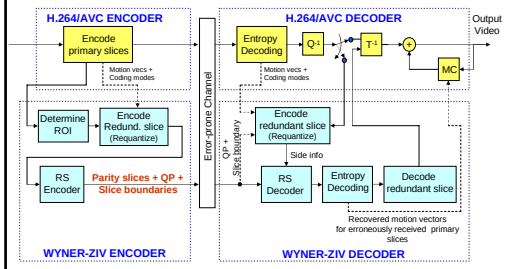



- Analogous to systematic source/channel coding *[Shamai, Verdù, Zamir, 1998]*
- Error corrected up to a distortion introduced by coarse WZ quantizer, hence lossy protection *[Rane, Aaron, Girod, ICIP 2003]*



## Systematic Lossy Error Protection (2/5)

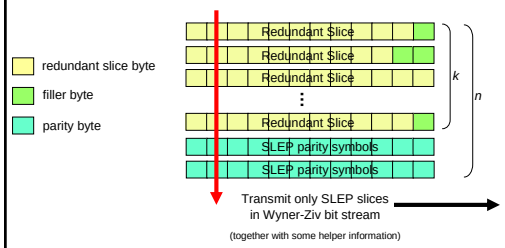
- H.264/AVC codec implementation -






## Systematic Lossy Error Protection (3/5)

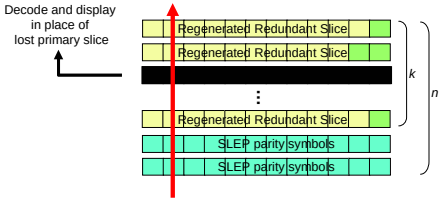
- Reed-Solomon Encoder -





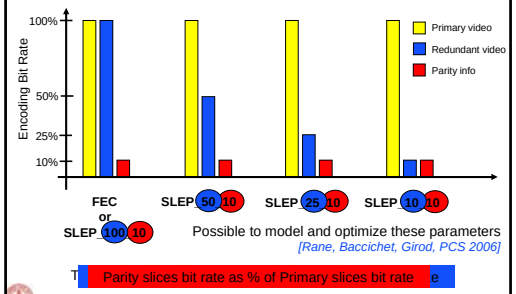

## Systematic Lossy Error Protection (4/5)

- Reed-Solomon Decoder -



## Systematic Lossy Error Protection (5/5)

- One more degree of flexibility Vs. FEC -




Possible to model and optimize these parameters

*[Rane, Baccichet, Girod, PCS 2006]*

Parity slices bit rate as % of Primary slices bit rate



## Simulation Results (1/4)

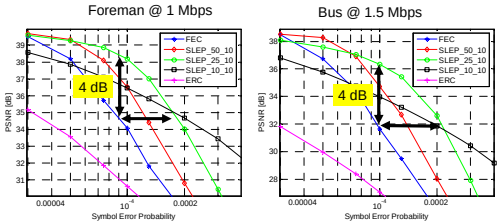
- Experimental setup -

- H.264/AVC (JM 10.1) "primary" bitstream at constant bit-rate
- WZ Codec → Redundant slice generation tool (Coarse QP) + Reed-Solomon codec
- GOP structure : *I-P-P-P-…* with one forced intra MB line per frame
- JVT non-normative error concealment
- Two Considered Scenarios
  - Wireless transmission with symbol errors
  - Internet video transmission with packet losses due to congestion
- Average over 30 independent random traces



## Simulation Results (2/4)

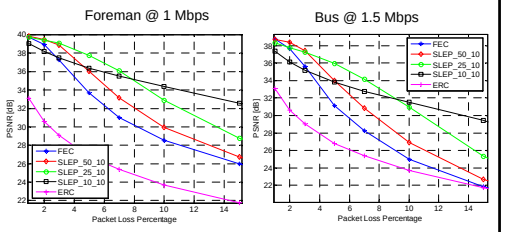
- Wireless Scenario -






## Simulation Results (3/4)

- Internet Scenario -






## Simulation Results (4/4)

**Primary bit rate 1Mbps, Parity bit rate 100 kbps**

Symbol error probability = $2 \times 10^{-4}$

**FEC**

PSNR: 32.5 dB

Recovered MBs: 2539
Erroneous MBs: 2183

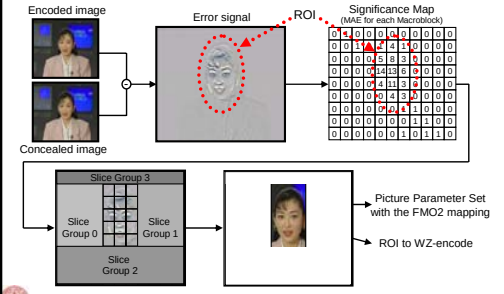
**SLEP_25_10**

PSNR: 38.0 dB

Recovered MBs: 4561
Erroneous MBs: 161

## SLEP on ROI for low motion sequences (1/3)

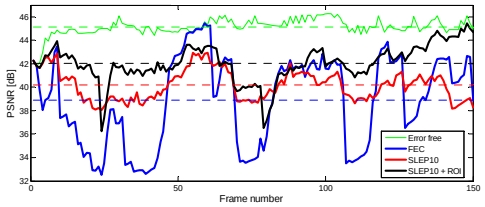
- ROI determination procedure -



## SLEP on ROI for low motion sequences (2/3)

- Benefits of the ROI -

Akiyo @ 400 kbps




Symbol error rate = 3 x $10^{-4}$



## SLEP on ROI for low motion sequences (3/3)

**Primary bit rate 400 kbps, SLEP bit rate 40 kbps**

Symbol error rate = 3 x $10^{-4}$

**SLEP_10_10**

PSNR: 40.2 dB

Recovered MBs: 6826
Unrecovered MBs: 0

**SLEP_10_10 + ROI**

PSNR: 42.1 dB

Recovered MBs: 737
Unrecovered MBs: 5155

## Conclusions

- SLEP mitigates the FEC cliff effect and ensures graceful degradation in error-prone environments
- Proposed implementation exploits tradeoff between quality of the redundant representation and error resilience
- SLEP on a Region-of-Interest improves performance for low motion sequences

SLEP standardization effort