Mosaicing Videos to Stream Over Multiple Independent Channels

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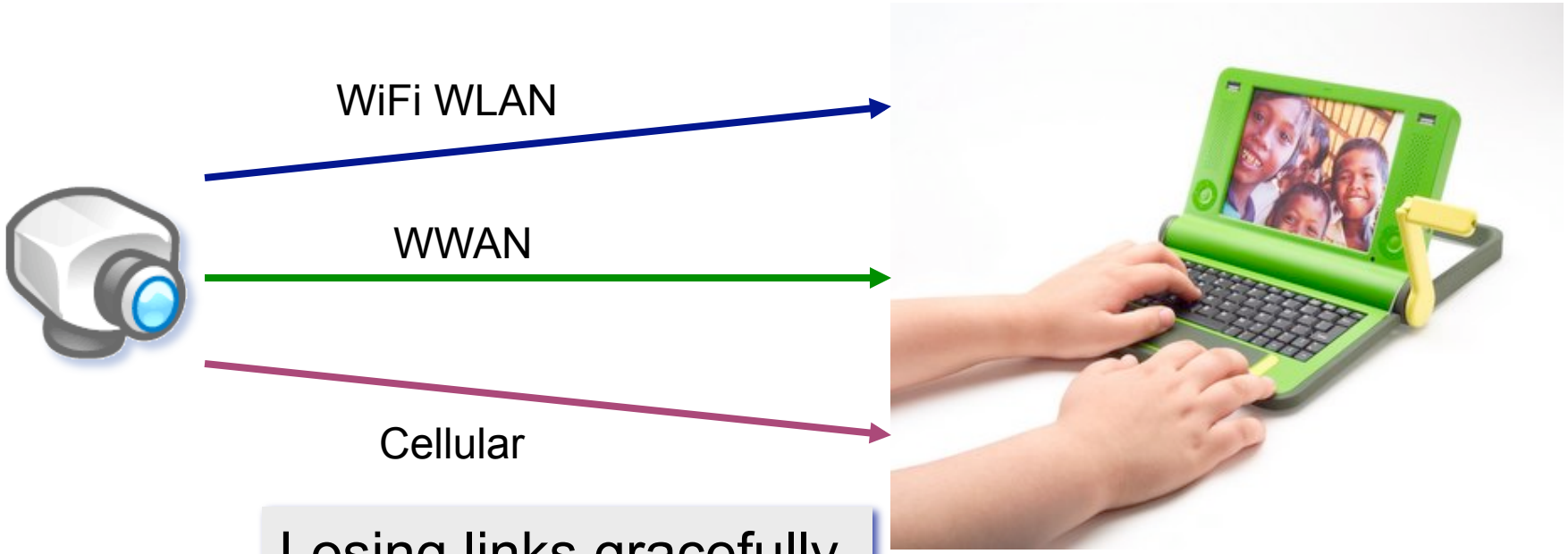
- Practical MDC to create independent sub-streams
- Illustrate scalable quality and compression overhead

Motivation - MDC

- Multiple Description Coding (MDC): Split stream into independent sub-streams
  - No sub-stream is critical
  - Final quality depends on the number of sub-streams available
- Compare with Layered encoding
  - Enhancement layers require base layer
  - E.g., P and B frames require I frame

Motivation - Applications

- Some users fail to receive some streams



Losing links gracefully degrades quality

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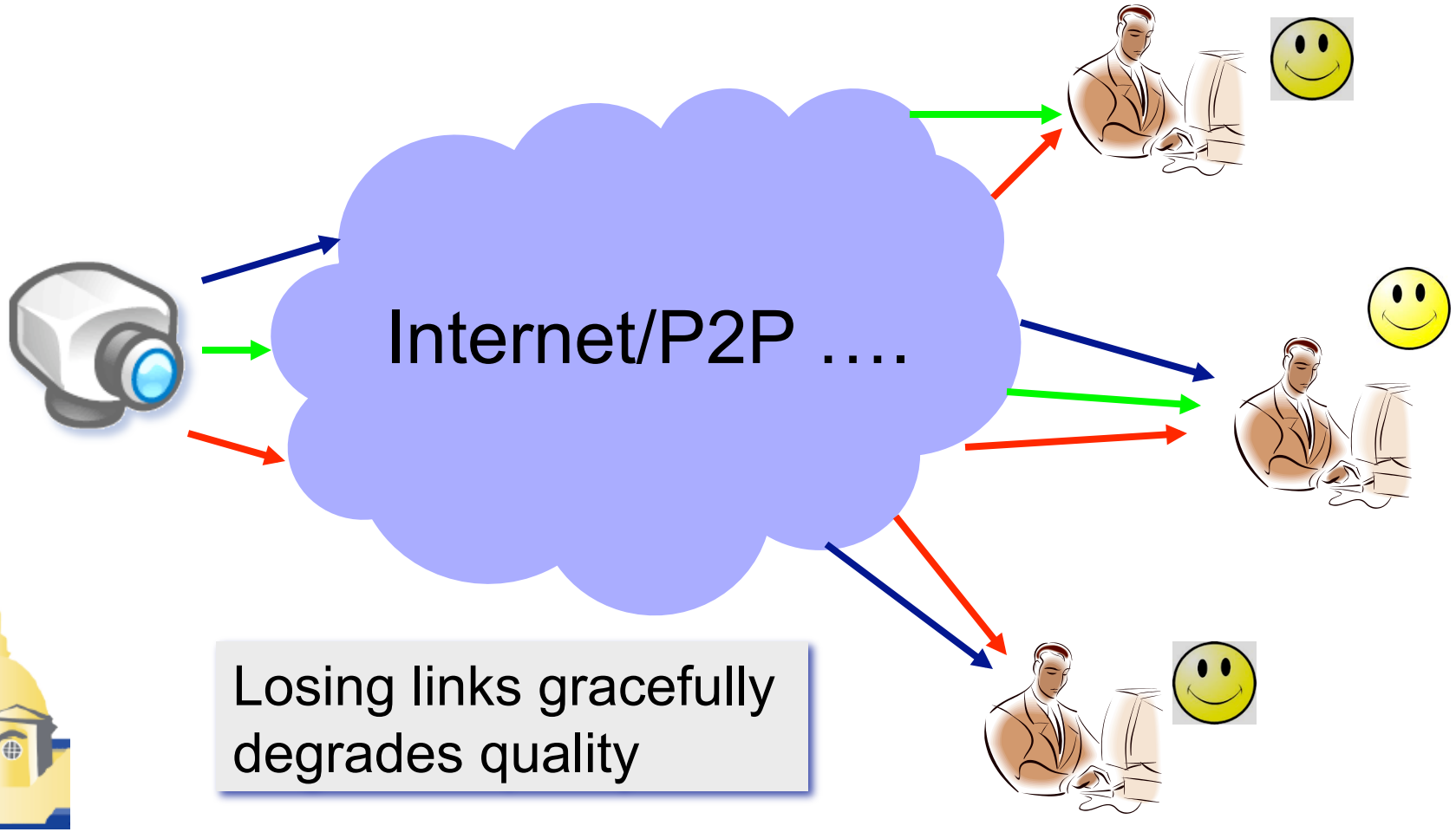

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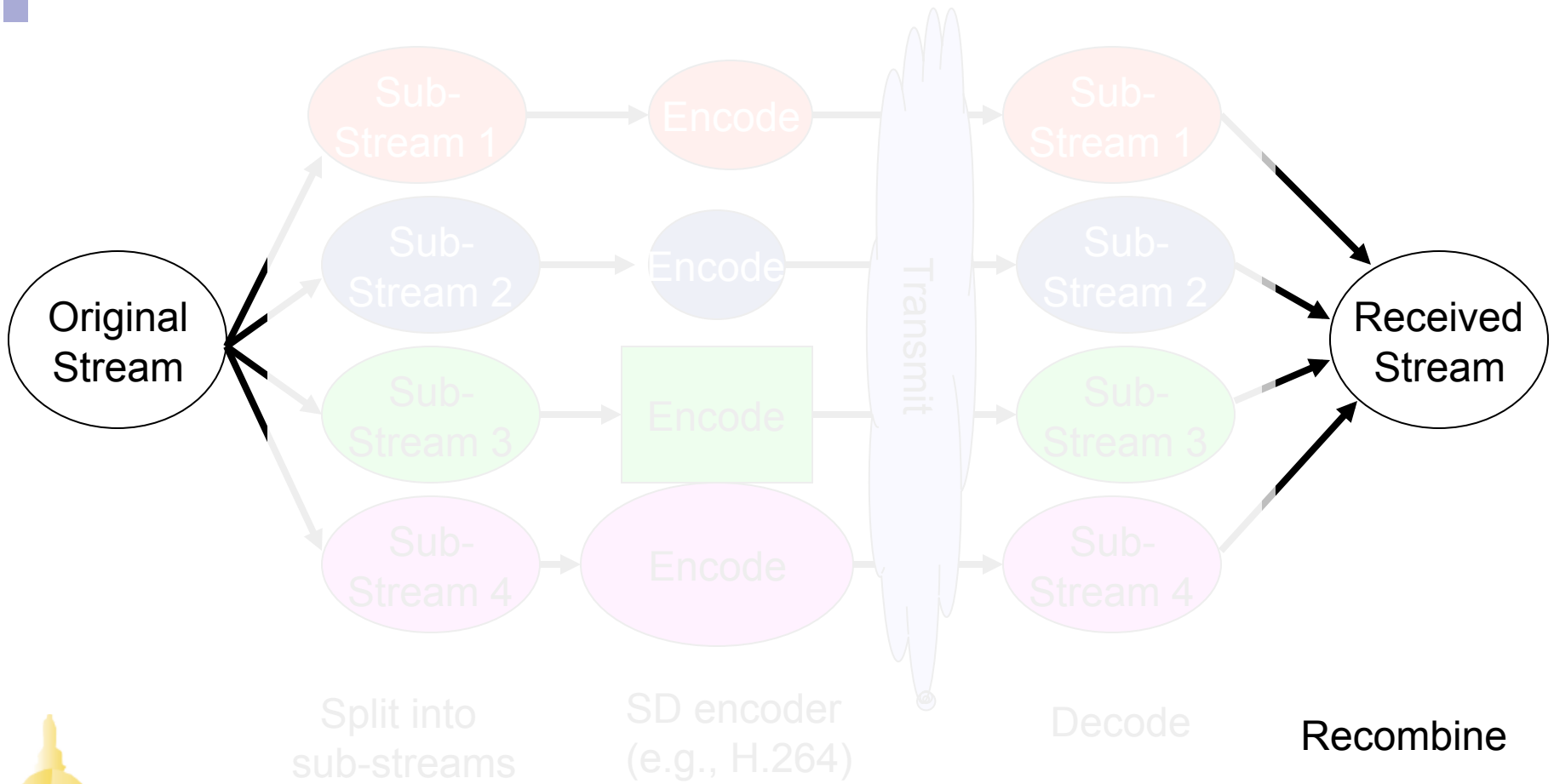
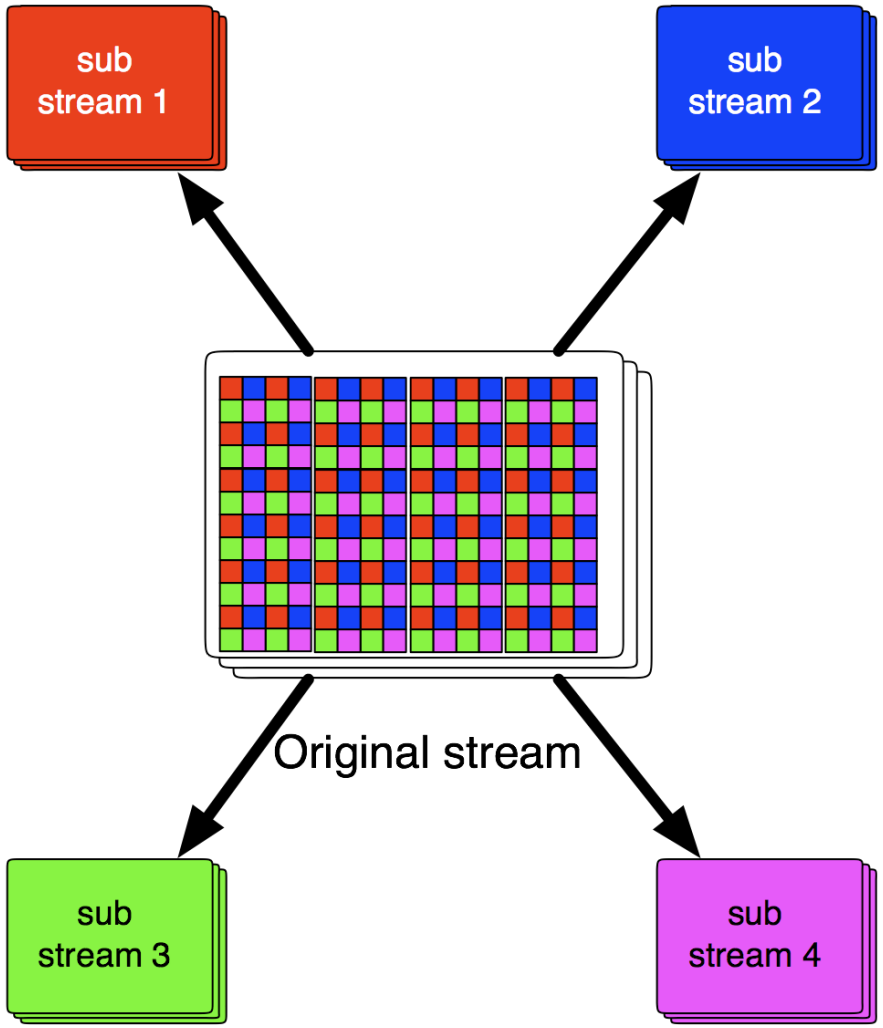
Our approach



Approach: Stream splitting

- Spatial
  - Neighboring pixels sent to different sub-streams
  - Reconstructed using pixel averaging
  - Retain some temporal redundancy for H.264



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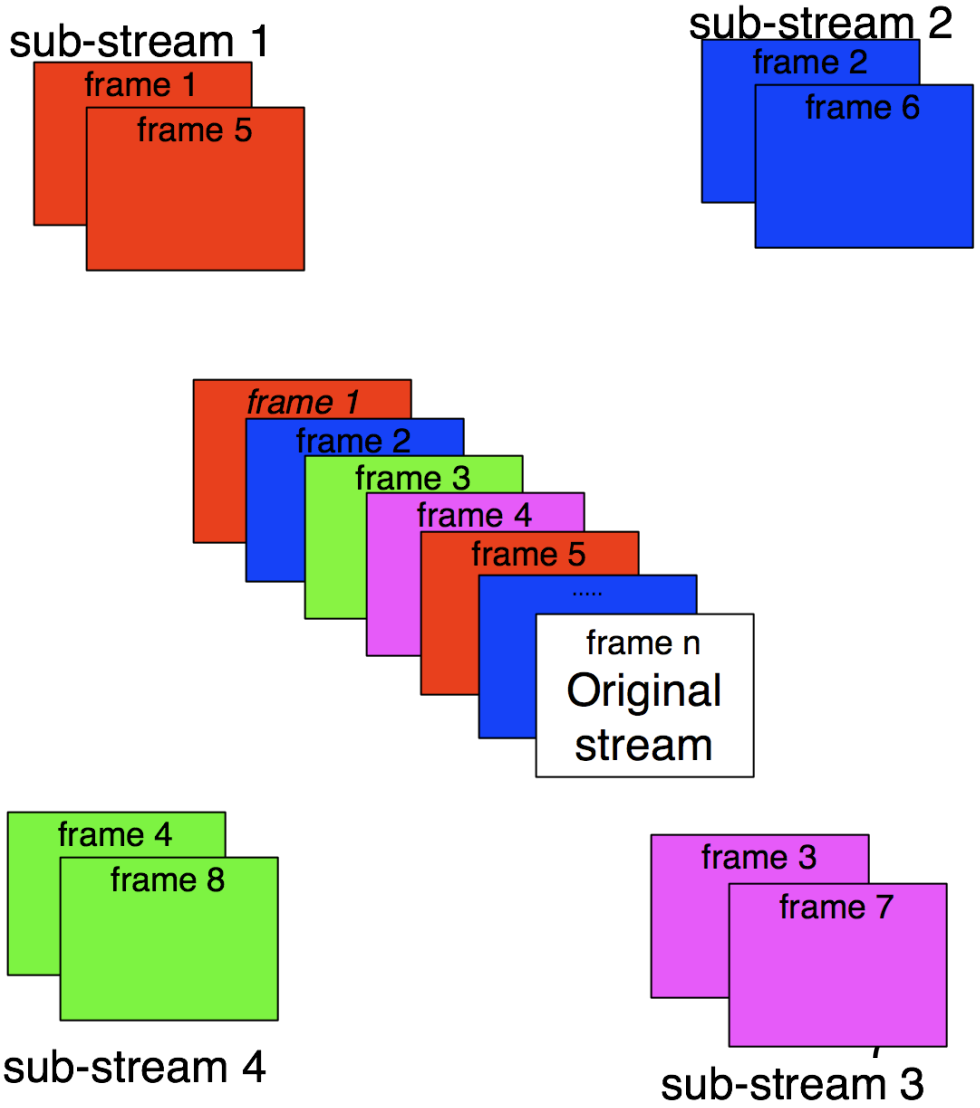
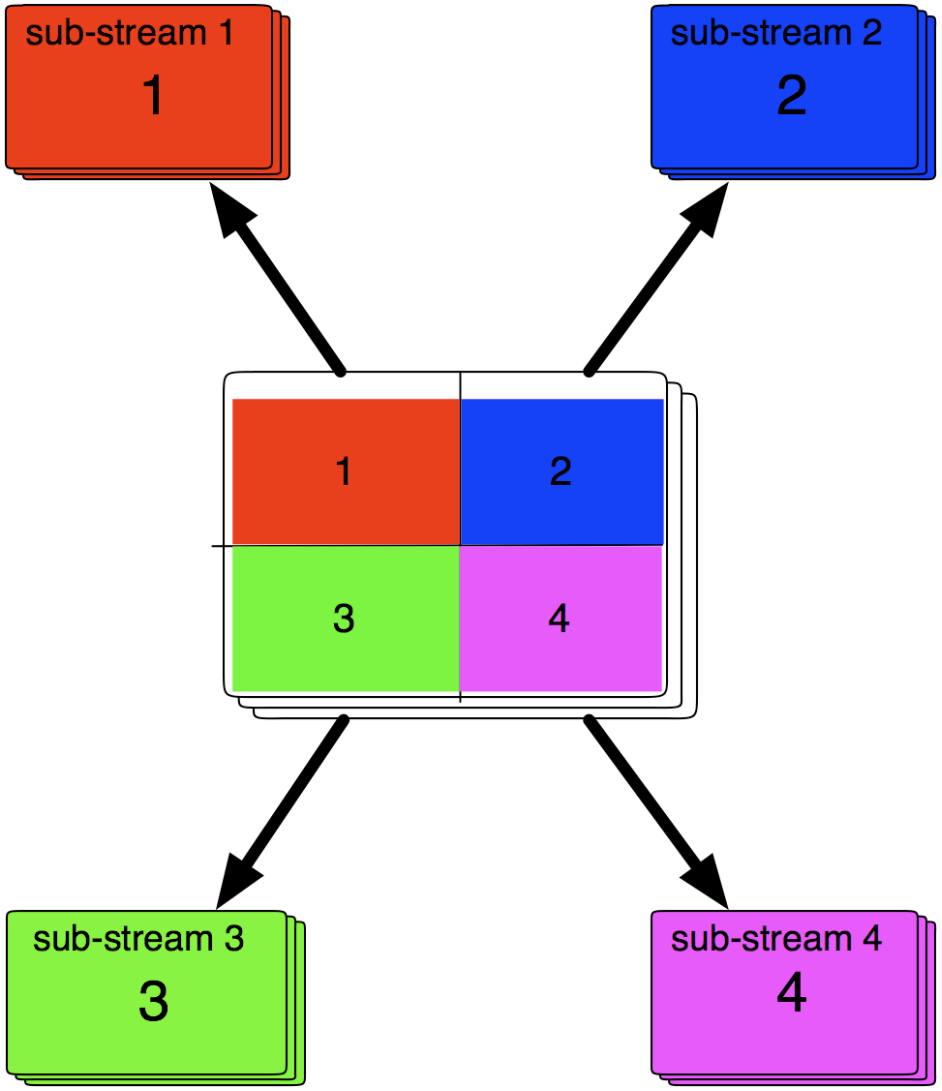
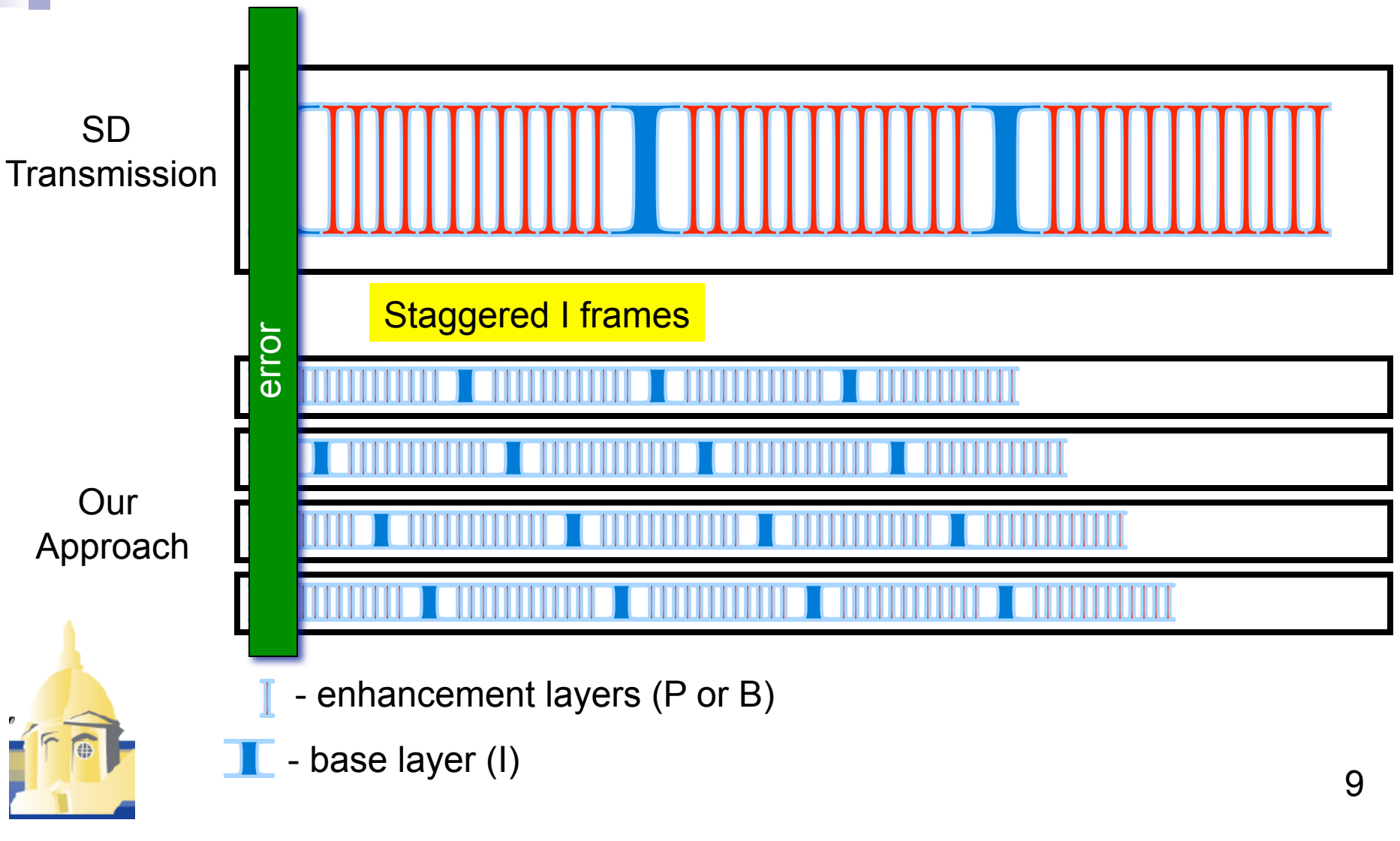


Approach: Stream splitting

- Quadrant based
  - Split frame into equal quadrants
  - Retain some spatial and temporal redundancy
  - Sub-streams may not be equal size



Transmission Error Resiliency



Evaluation Dataset

- NDSet
  - Plain background, little movement
  - CVRL data acquisition
- MotorcycleSet
  - Heavy motion
  - www.motorcycle.com/mo/mcvideos/videos.html

QuickTime™ and a
decompressor
are needed to see this picture.

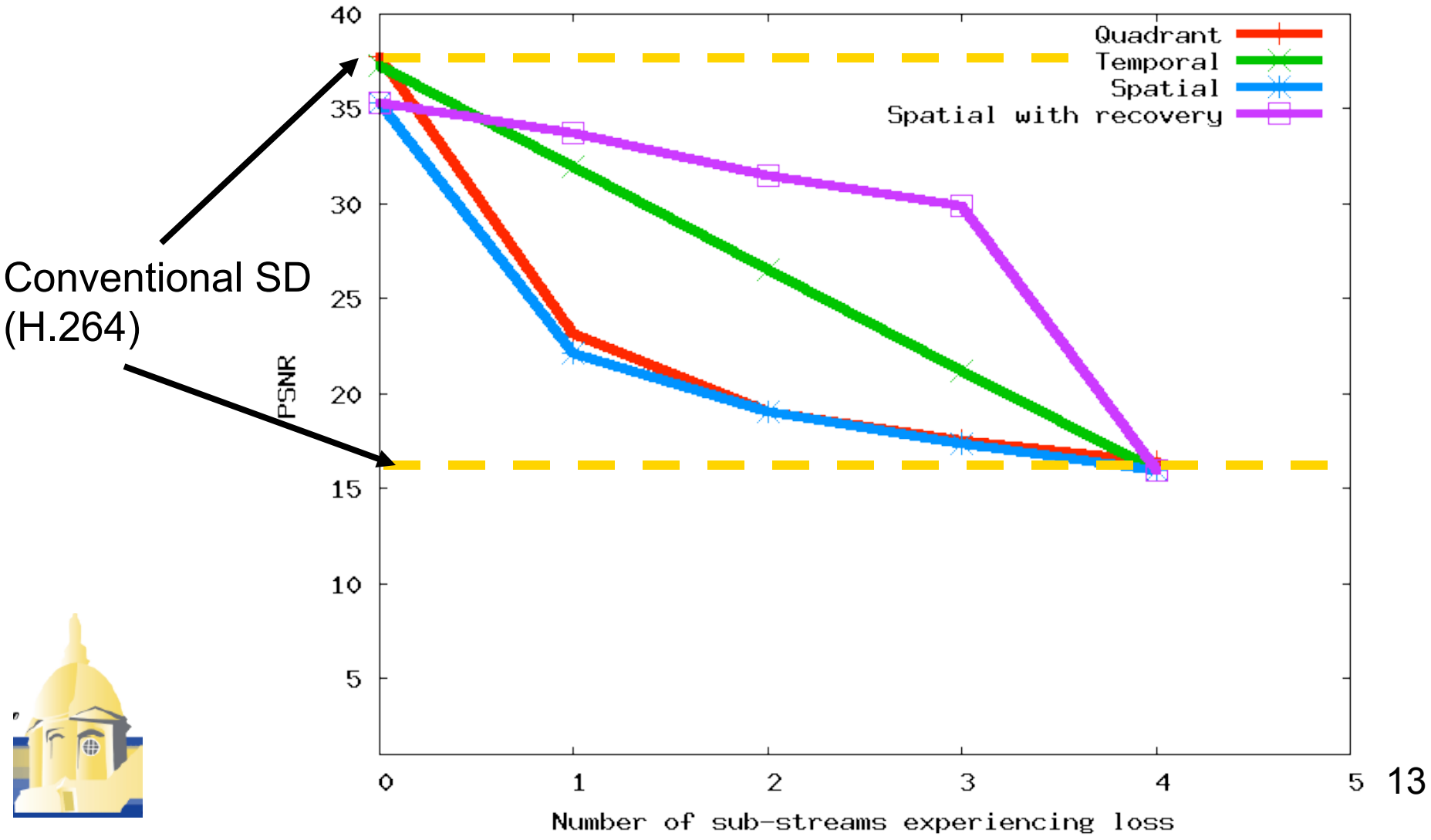
Experiments

- Resiliency to stream loss
  - PSNR - Original vs Recombined stream
    - With and without data loss
  - Prefer: graceful degradation
- Sub-stream characteristics
  - Encoding parameters for each sub-stream
  - Discussed in paper
- Peak stream requirement
  - Prefer: uniform rather than spiky
    - E.g., Tavarua used multiple cellular links

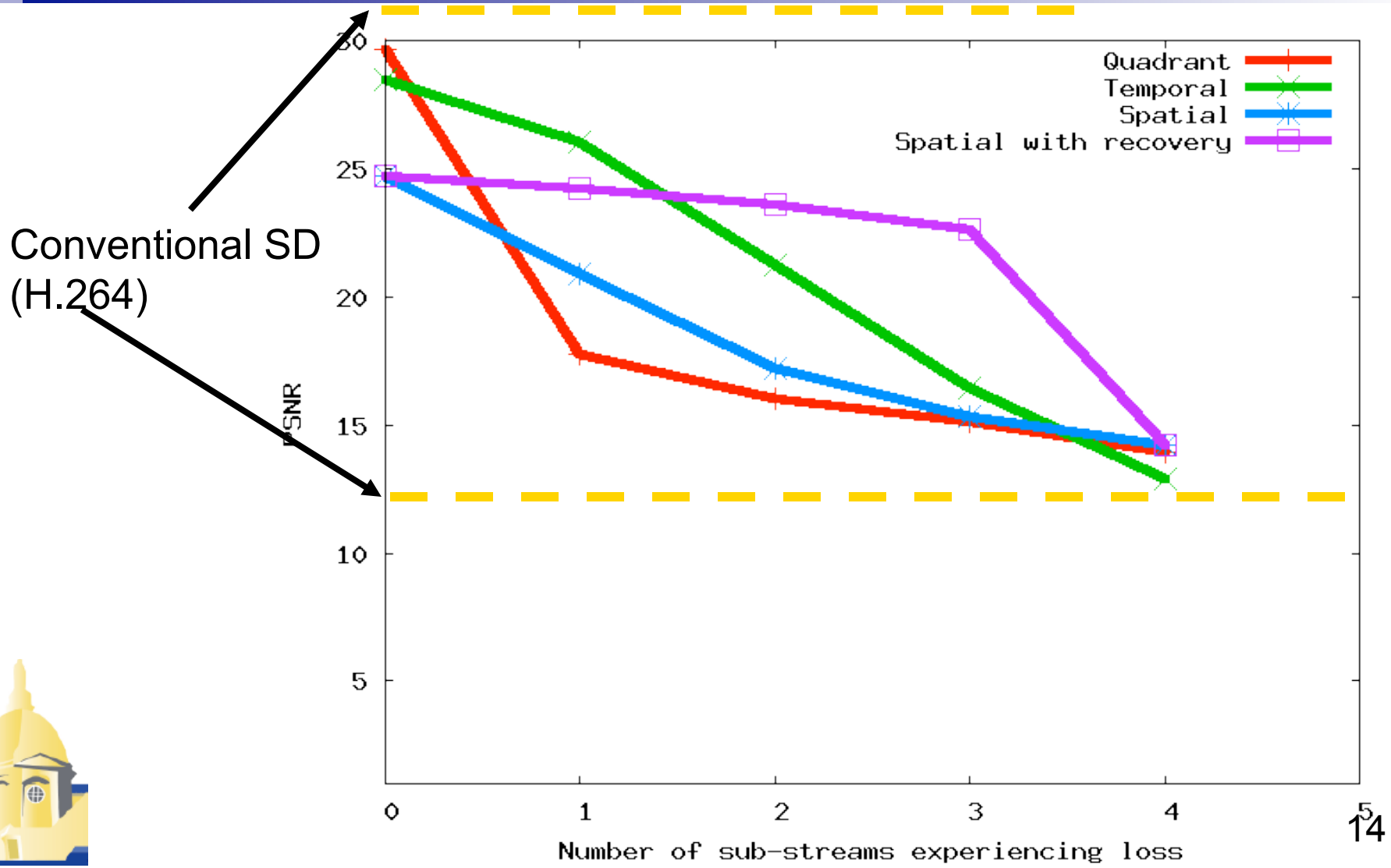
Results - Data Loss

- Worst case data loss: initial 1500 bytes of I-frames zero'd
- Traditional Method: 1500 bytes per I-frame
- Sub-stream methods
  - experimented with 1, 2, 3 and all streams
    - 1500 byte per stream or four times data loss

Results: ND – Zero'd all I-frames



Results: Motorcycle - Zero'd all I-frames



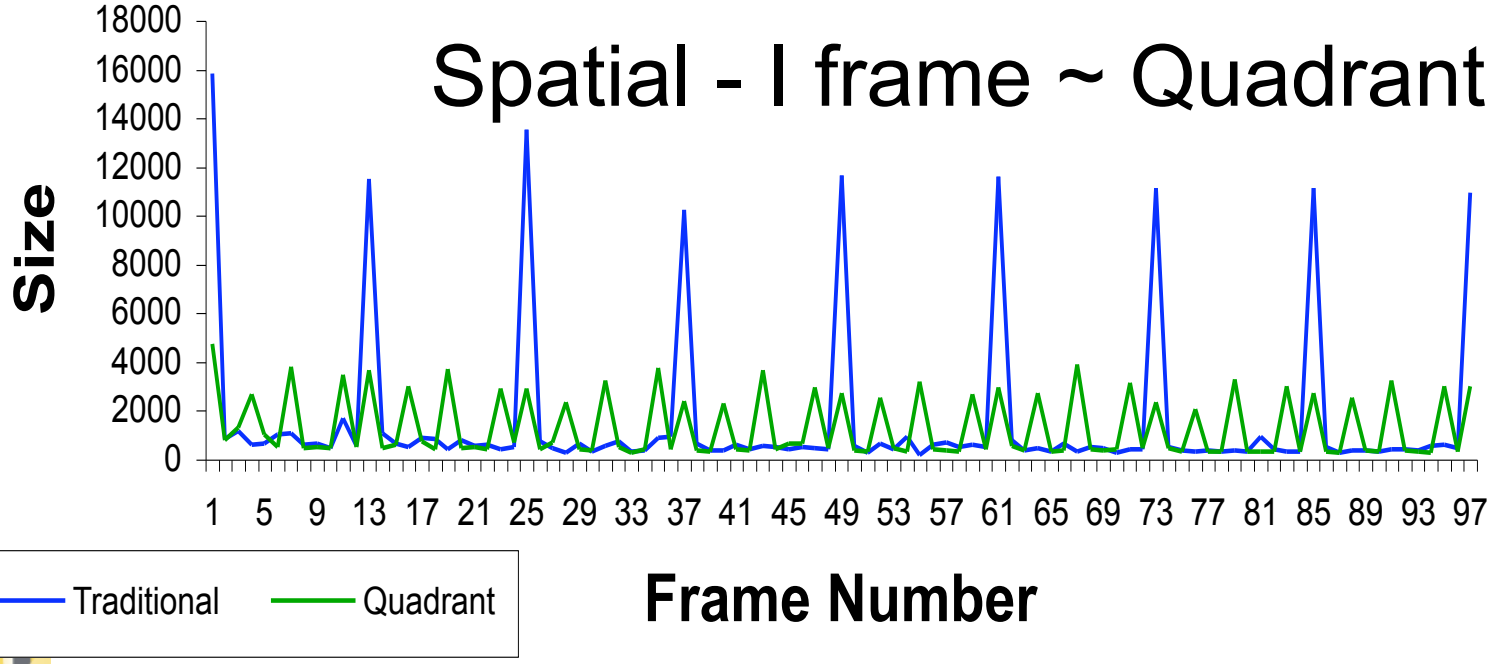
Results: ND - frame size

Sub-streams smoother

Less demand on each link

Temporal - I frame ~ Traditional

Spatial - I frame ~ Quadrant



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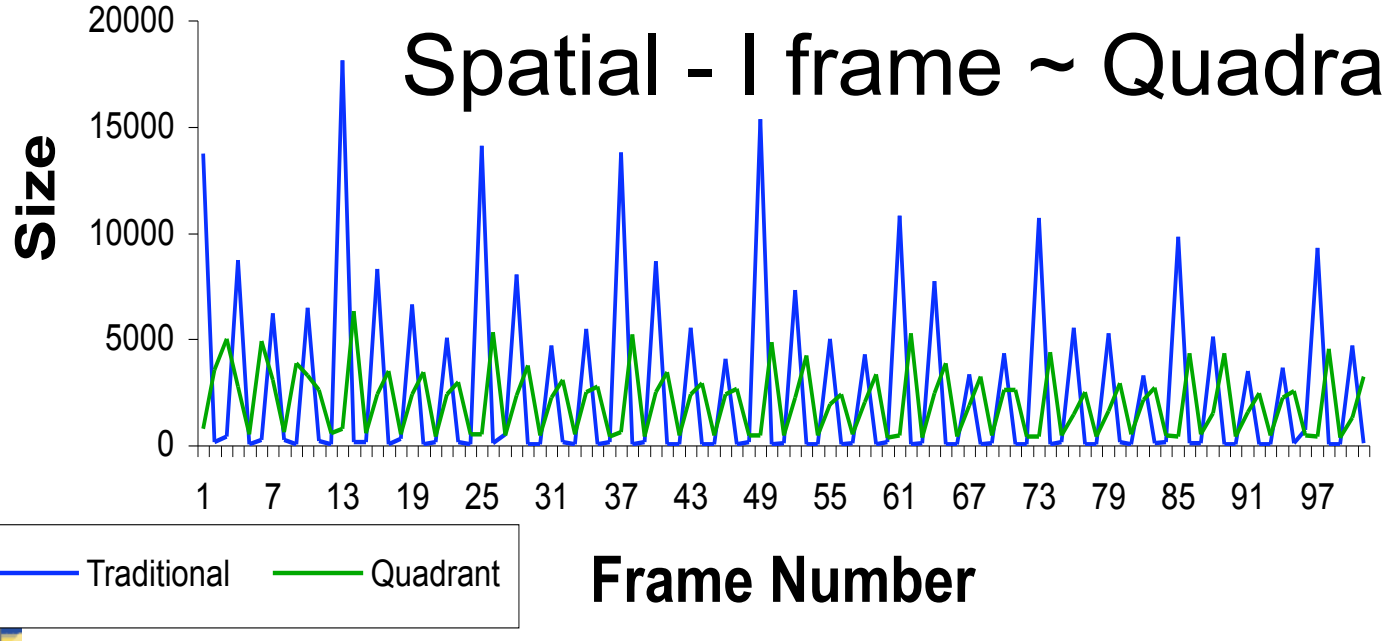


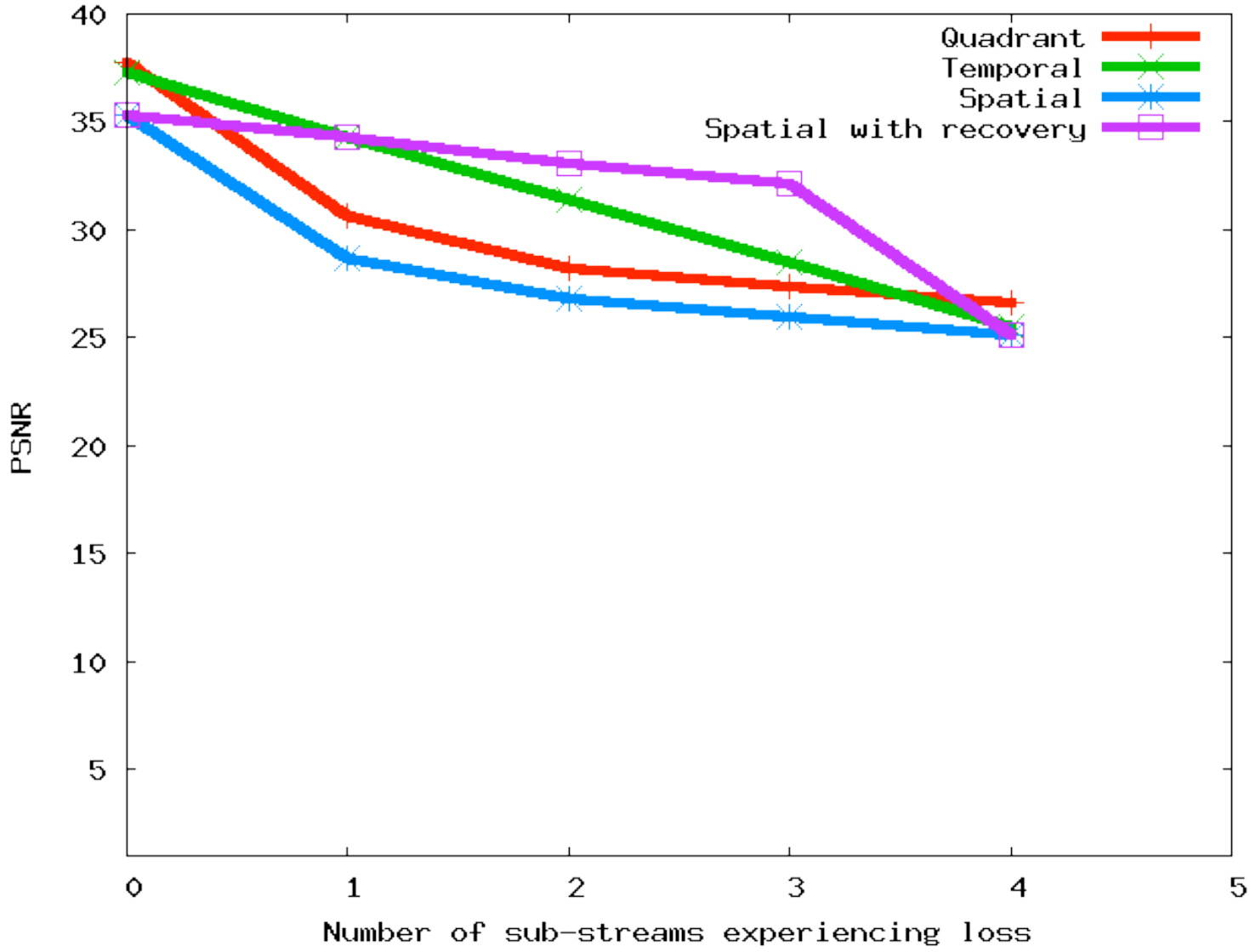
Conclusions

- MDC functionality using SD encoders
  - Sub-stream independently encoded
    - MDC higher overhead versus SD coding
- Temporal: Bursty transmission
  - I frame ~ original
- Spatial: fault tolerant
  - high overhead (lost spatial redundancy)
- Quadrant: low compression overhead
  - fault tolerant: iff lost quandrant was unimportant

Future Work

- Adaptive sub-stream compression parameters
- Generate sub-streams in compression domain
- Versatile sub-stream creation (not just four)

Results: ND- half I-frame



Results: Motorcycle- half I-frame