



JPEG-LS Standard and efficient power management for wireless video transmission

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Problem statement

- Future 802.15.3 [60GHz init]
 - Wireless Display will use it for video transmission
 - Video transmission – primary usage model
 - Low Complexity Costs
 - Transmission Rate < 4 Gbps
- WD HDTV 1080p
 - Resolution 1920x1080x60 fps
 - Real Time video with minimum delay (<60ms)
 - Low Complexity Costs
 - Rate ~3.6 Gbps

Future 802.15.3 is ready for
HDTV 1080p video!

WHY additional lossless compression is needed ?

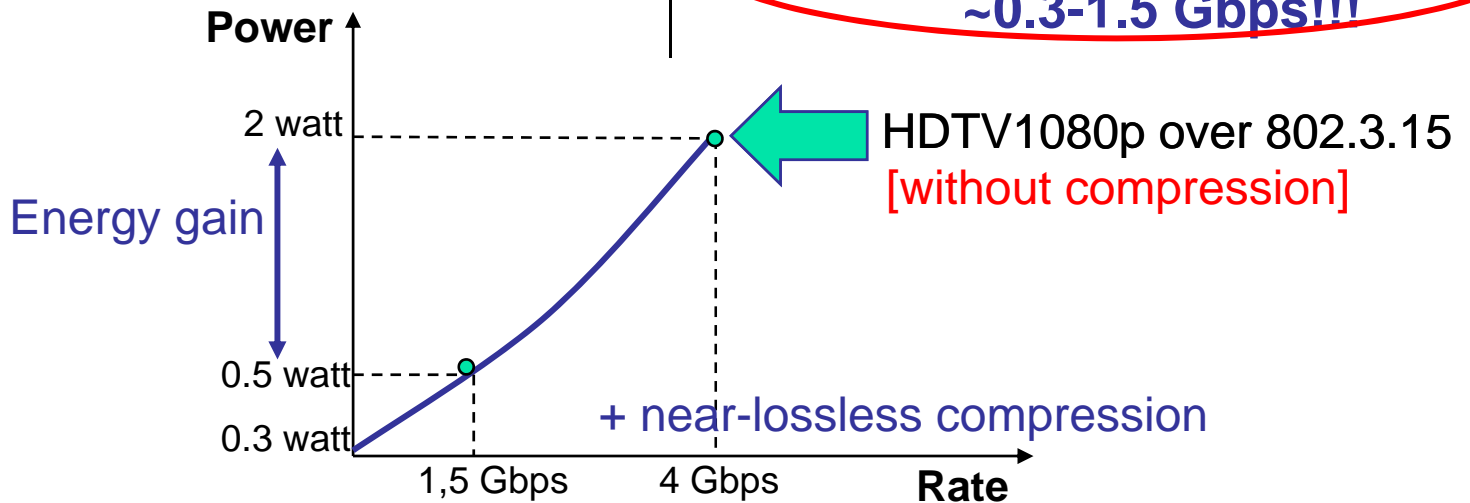
Problem statement

- Future 802.15.3 [60GHz init]
 - Wireless Display will use it for video transmission
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- WD HDTV 1080p ^{+ near-lossless compression}

- Resolution 1920x1080x60 fps
- Real Time video with minimum delay (<60ms)
- Low Complexity Costs
- Rate ~~~3.6 Gbps~~

~0.3-1.5 Gbps!!!





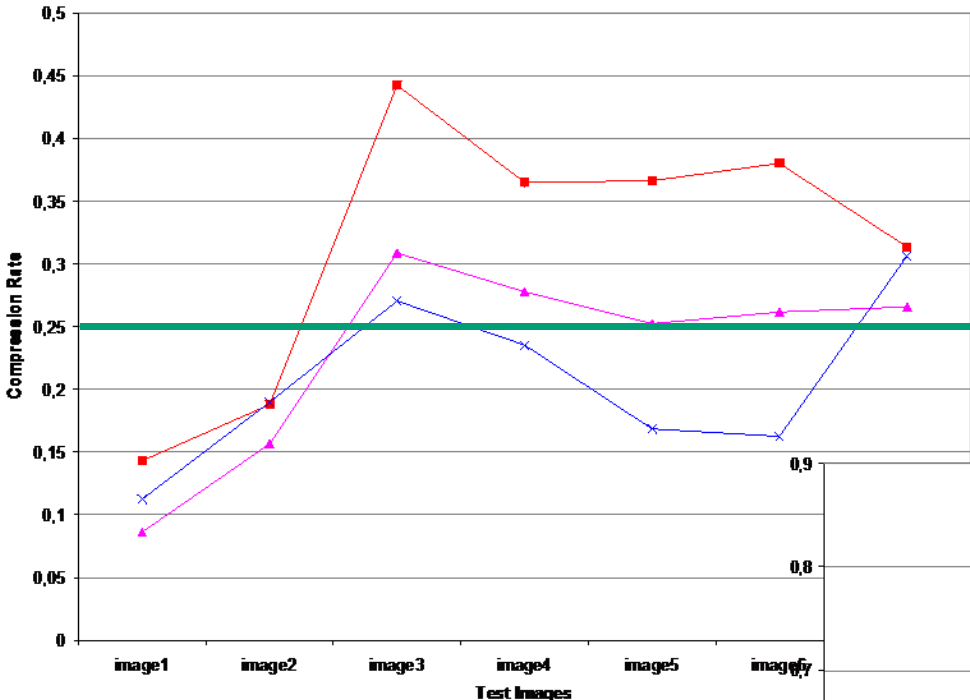
Lossless Wireless Display: 802.15.3 & HDTV 1080p & JPEG-LS

- Future 802.15.3 [60GHz init]
 - Wireless Display will use it for video transmission
 - Video transmission – primary usage model
 - Low Complexity Costs
 - Transmission Rate < 4 Gbps
- WD HDTV 1080p+ **JPEG-LS**
 - Resolution
1920x1080x60 fps
 - Real Time video with minimum delay (<60ms)
 - Low Complexity Costs
 - Rate ~0.3 – 1.5 Gbps

JPEG-LS Lossless video compression
decreases power consumption !

WHY JPEG-LS ?

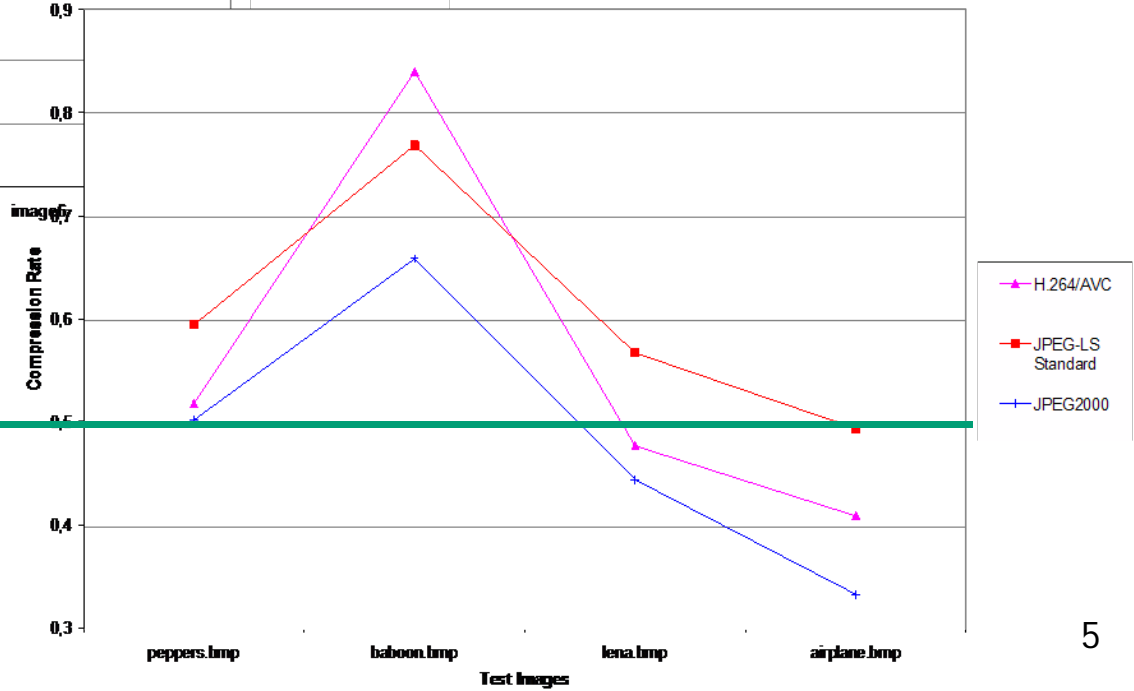
Compression rate: JPEG-LS vs. JPEG2000 vs. H.264/AVC(Intra)



Complicated computer graphics + photos:
4 times compression

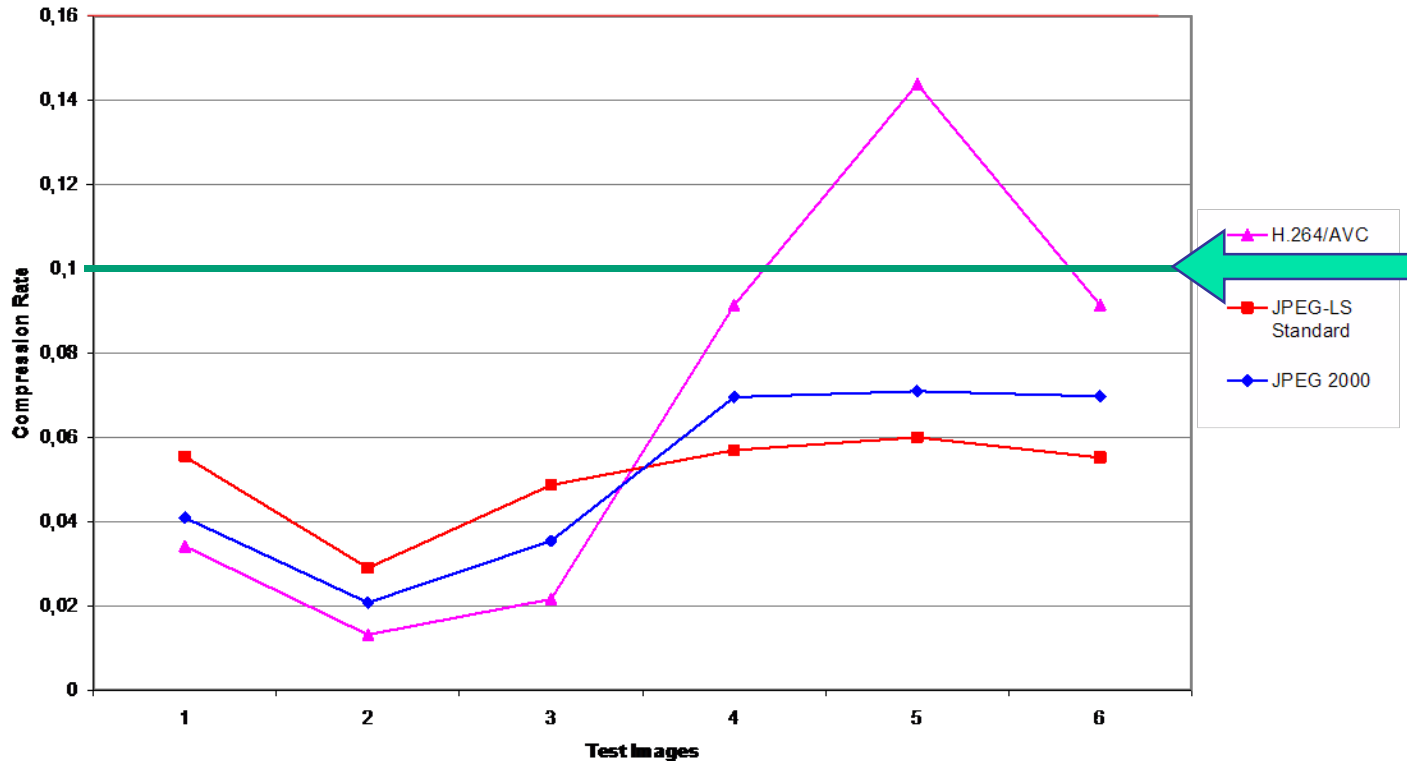


Photorealistic images:
2 times compression



Compression rate:

JPEG-LS vs. JPEG2000 vs. H.264/AVC(Intra)

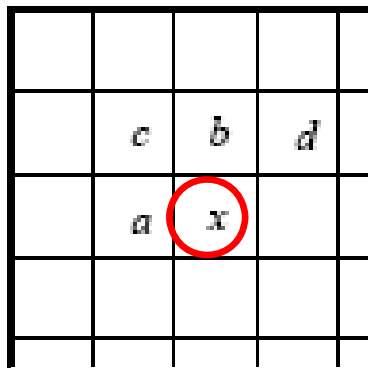
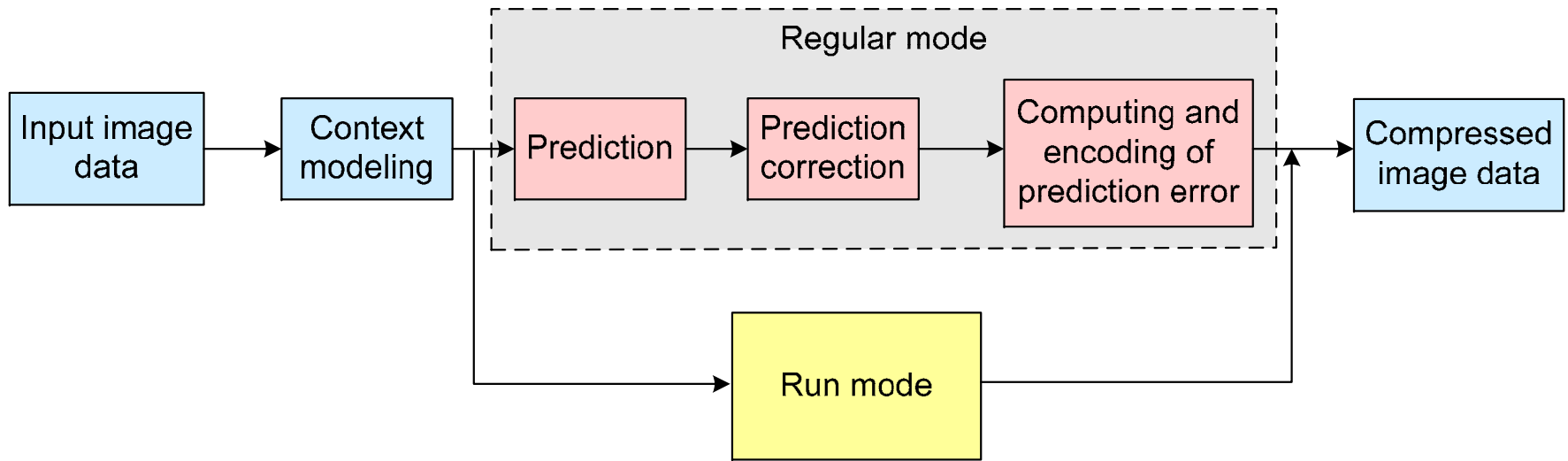


Complicated computer graphics + text:
10 times compression

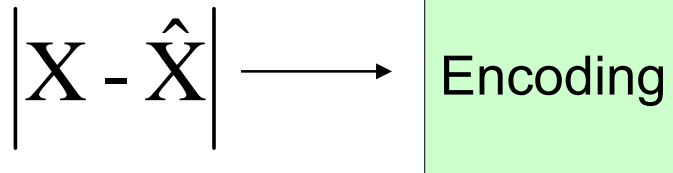
JPEG-LS provides
the **same compression rate** with much
smaller level of implementation complexity¹

¹Diego Santa Cruz and Touradj Ebrahimi, A study of JPEG 2000 still image coding versus other standards. Published in the proceedings of EUSIPCO 2000

JPEG-LS: brief description



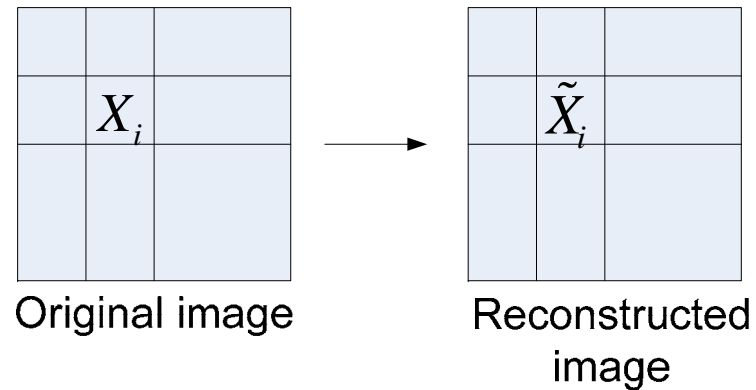
$$\hat{X} = f(a, b, c, d)$$



Quality vs. compression ratio

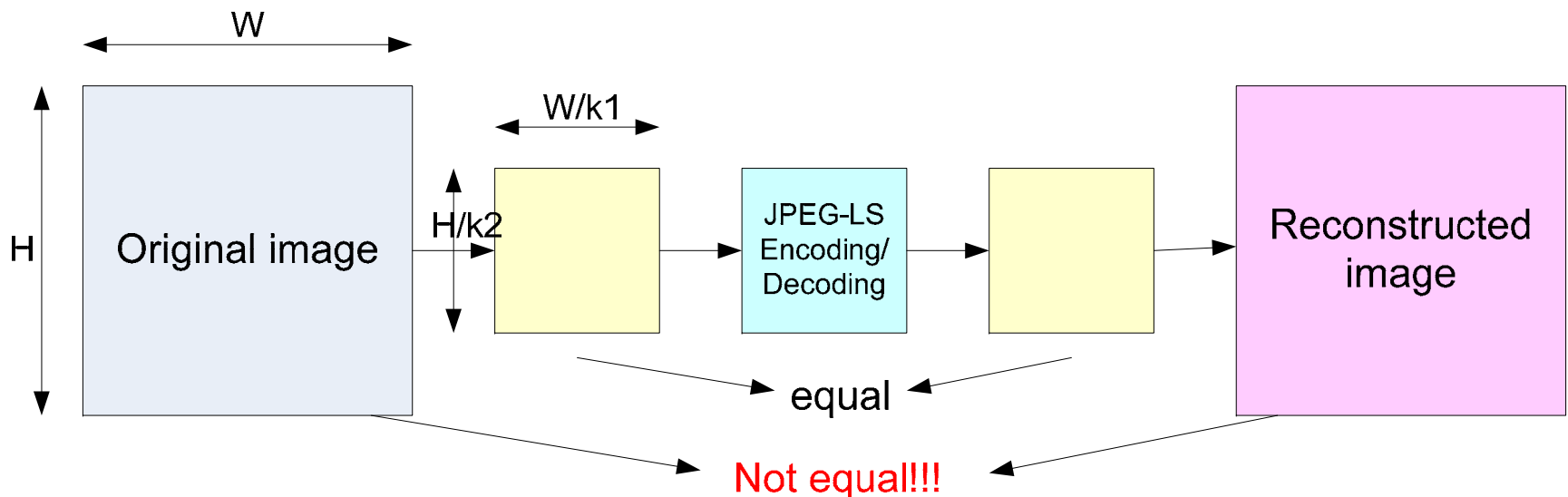
- Lossy factor

$$|X_i - \tilde{X}_i| \leq \text{Lossy factor}$$



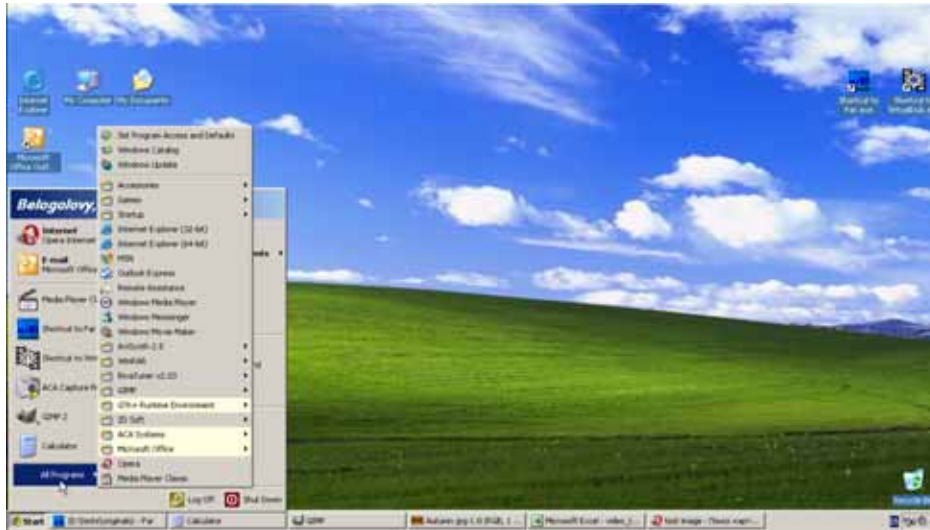
- Use two color spaces: RGB & YUV

- Subsampling

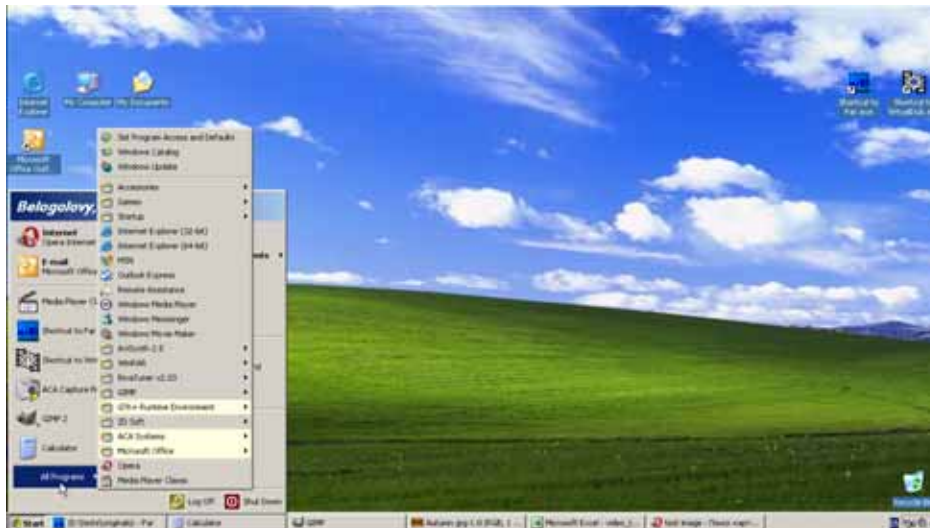


Test sequences: "Desktop"

Computer and synthetic graphics



"Desktop"
Original



"Desktop"
Compression ratio = 5

Test sequences: "Golf"

Photorealistic image

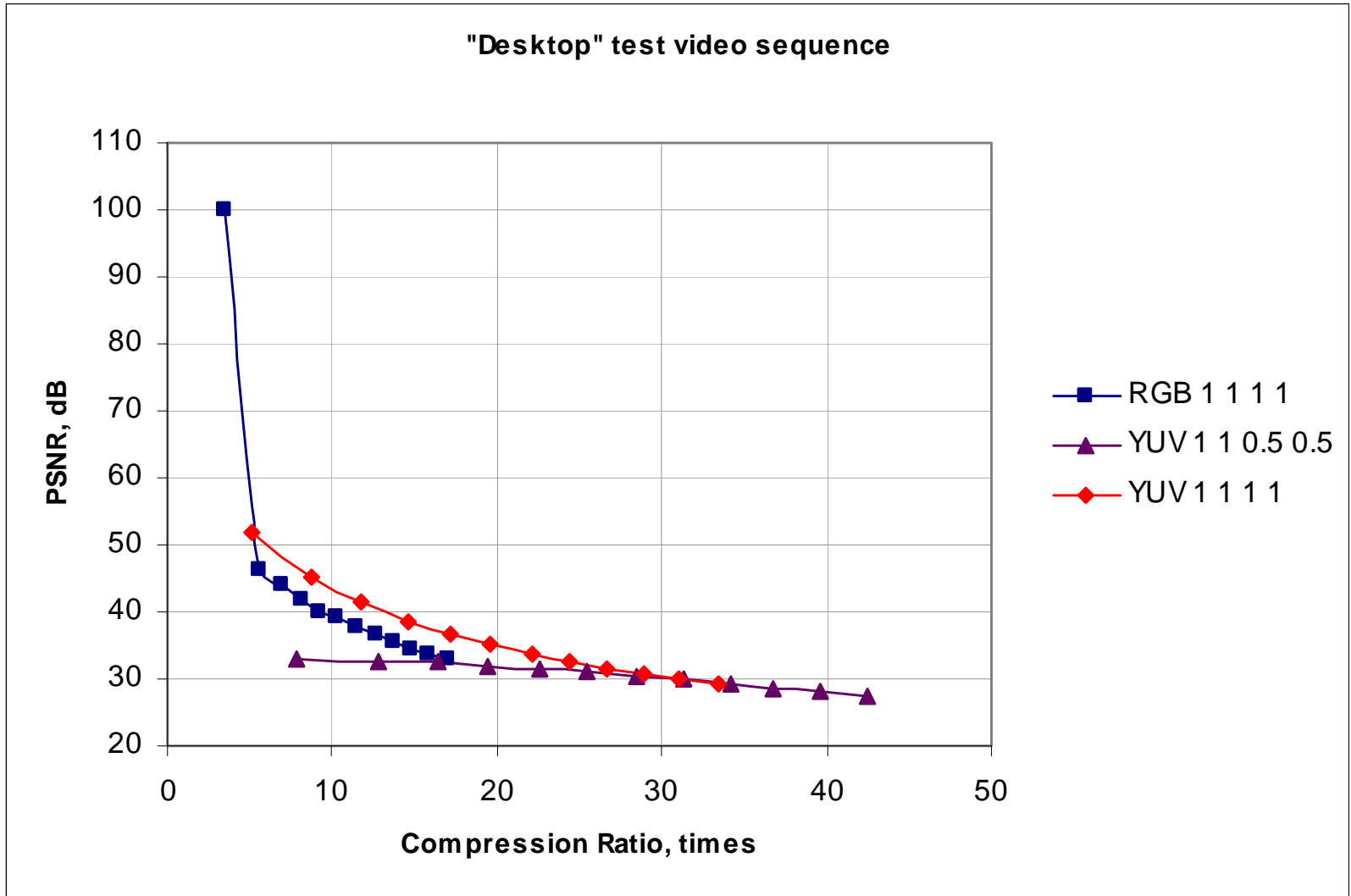


"Golf"
Original

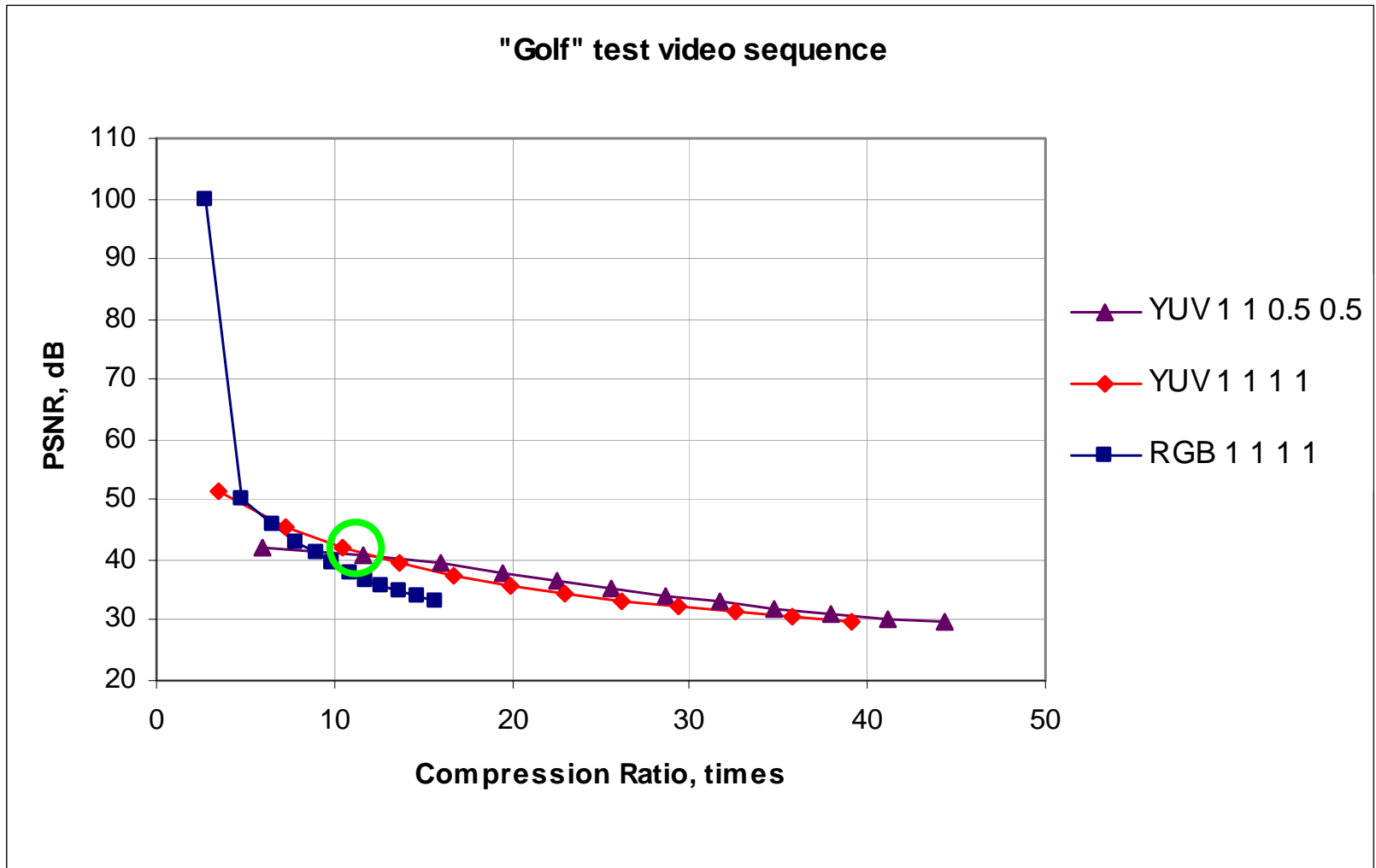


"Golf"
Compression ratio = 5

Graphs for "Desktop"



Graphs for "Golf"



Lossy factor vs. subsampling: artefacts

■ CR = 10

Lossy factor = 8, no subsampling



CR = 10

Lossy factor = 0, subsampling 0.5 0.5





Conclusion

- Compression ratio 2-5 times for future 802.15.3 [60GHz init]
- JPEG-LS provides necessary CR and high quality of the reconstructed image with low complexity
- Different ways how to adjust JPEG-LS for time-varying wireless channel

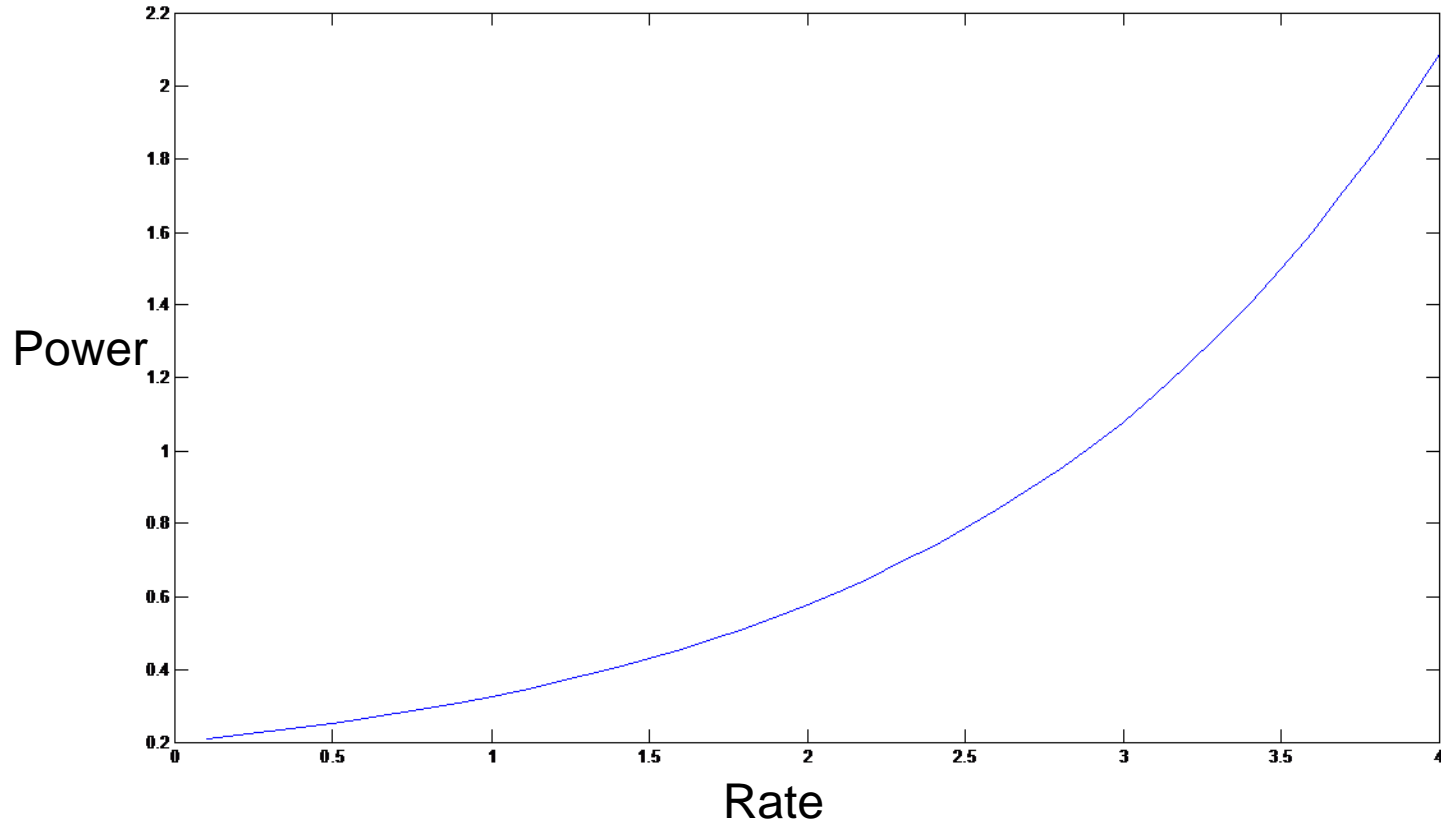
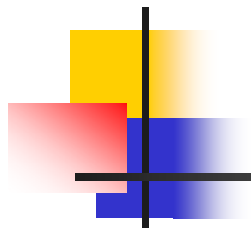
Research plans

- JPEG-LS Tiny with very low complexity
- Static detector



Questions?

Thank you!



Hongseok Kim, Gustavo de Veciano, “Leveraging Dynamic Spare Capacity in Wireless Systems to Conserve Mobile Terminals’ Energy”