

JVT-T029

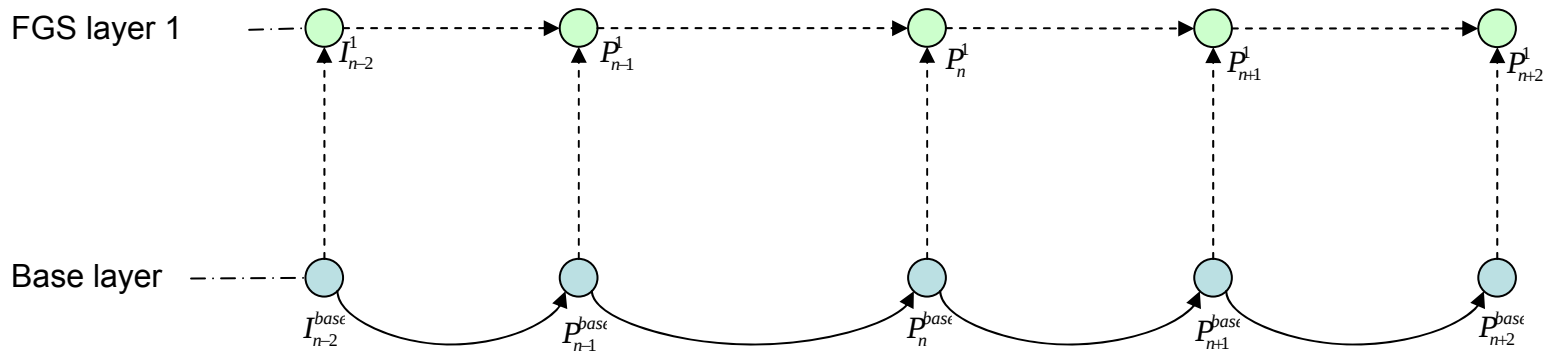
CE3 Tool 2: Switching between FGS layers with
reduced drift

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Canon

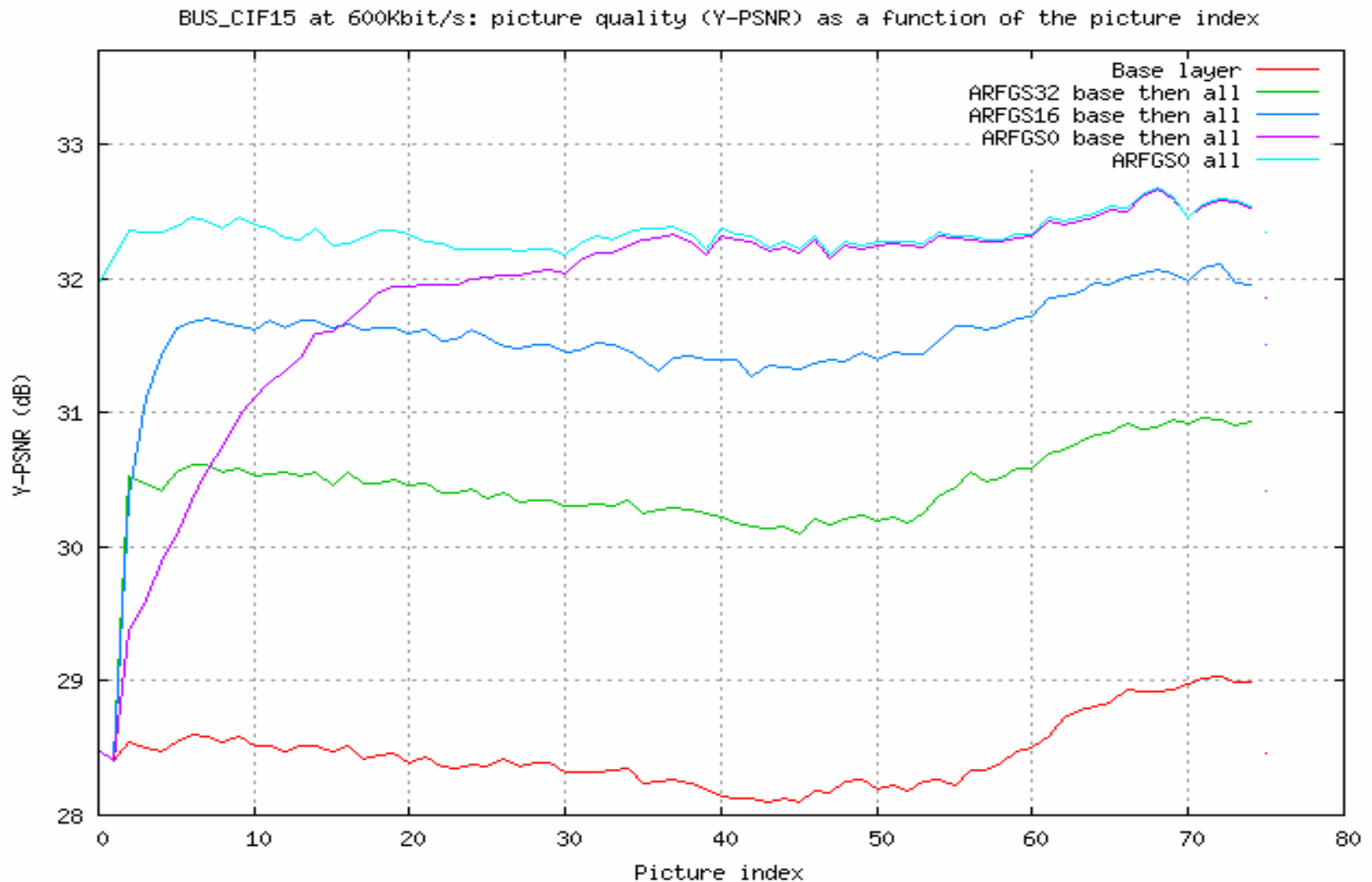
Context: low-pass pictures FGS coding

- AR-FGS technique:
 - Tradeoff between coding efficiency and drift control
 - Weighted average between enhancement layer and base layer reference data



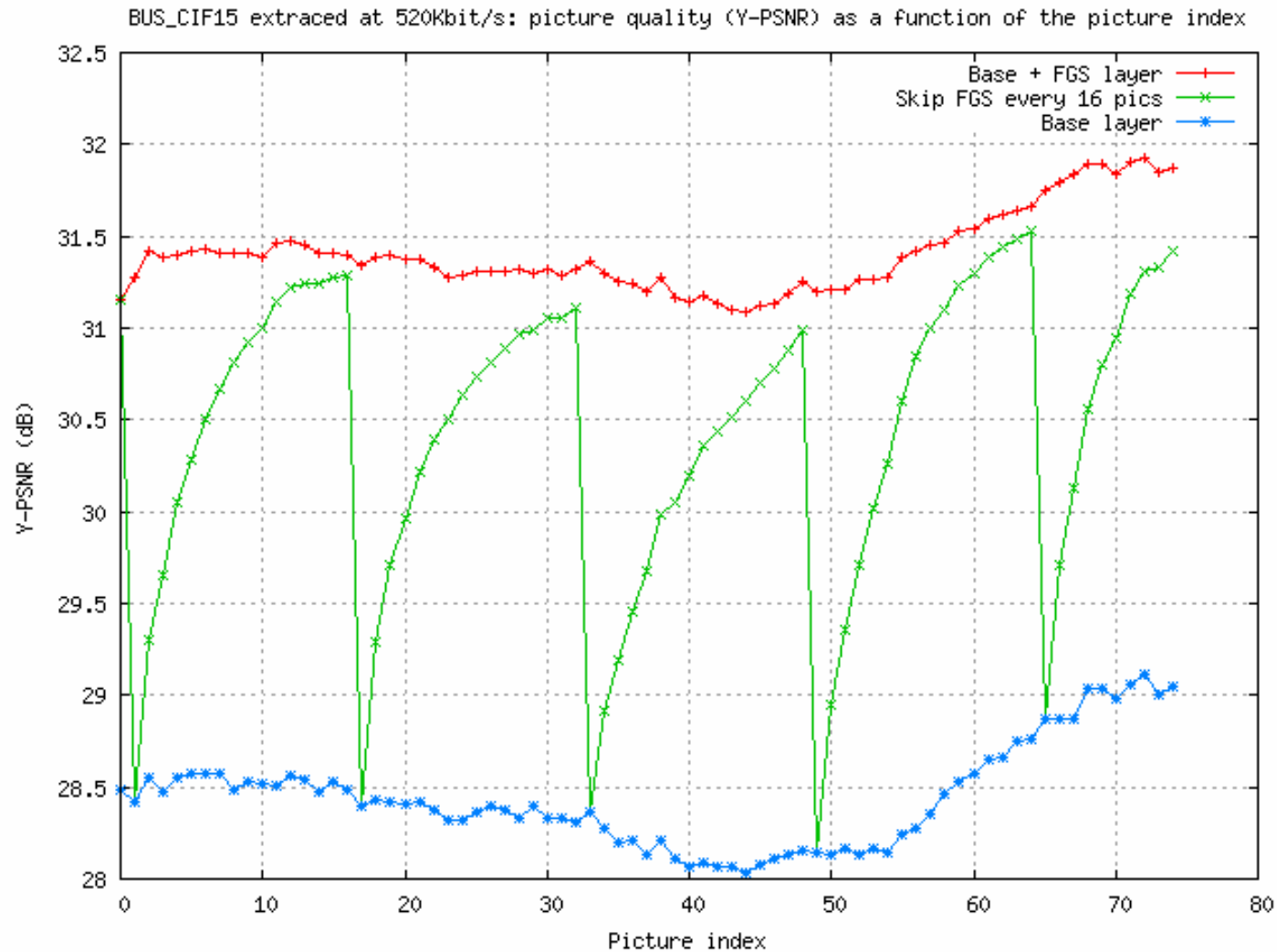
- Use of enhancement ref data $\rightarrow$ coding efficiency and drift
- Use of base layer reference data $\rightarrow$ lower coding efficiency and lower drift

Tradeoff: drift reduction/coding efficiency:



- Goal of the contribution: attempt to gather coding efficiency and decoder “refreshing capability”

Tradeoff: drift / coding efficiency:

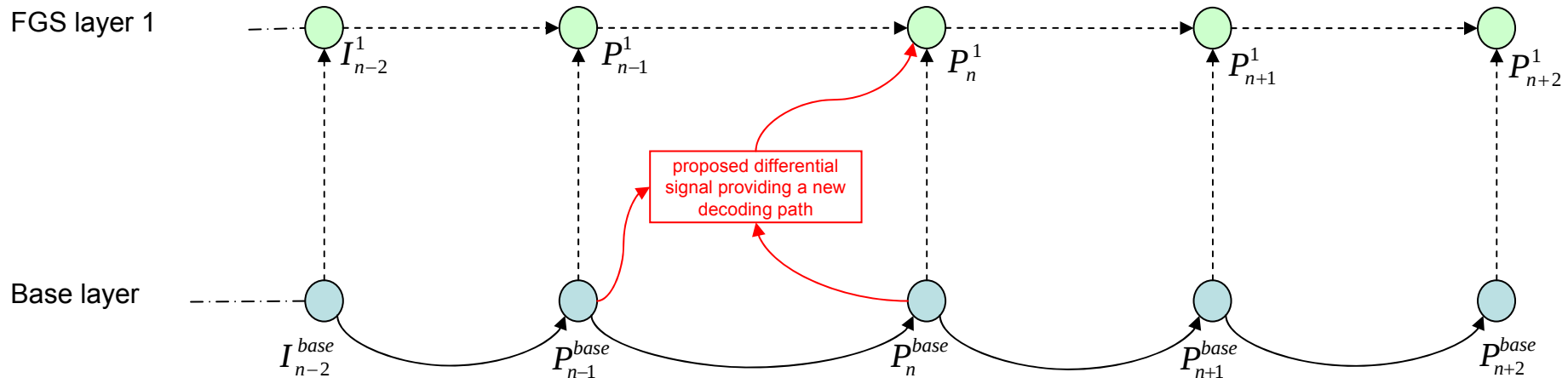


- Goal of the contribution: attempt to gather coding efficiency and decoder “refreshing capability”

Proposal

- Idea:

- Use of the AR-FGS technique with low weighting factors for the base layer zero blocks and coeffs → high coding efficiency
- Introduce a switching FGS signal enabling to jump from the base layer up to the FGS layer → only transmitted when switching up



- FGS encoded residual data:

$$\text{Reconstruction}(P_n^1) - \text{Motion_Compensation}(P_{n-1}^{base}) - \text{Residual}(P_n^{base})$$

- Coded data written in a NAL unit with a new slice type to indicate “switching FGS data”

Normative changes linked to our proposal

- Syntax changes:
 - Introduction of a new ‘SPR’ slice type: Switching Progressive Refinement slice
 - Slight modifications of the syntax elements (see JVT-T029):
 - “slice_layer_in_scalable_extension”
 - “slice_header_in_scalable_extension”
- Decoding process: no change

Experimental results: coding conditions

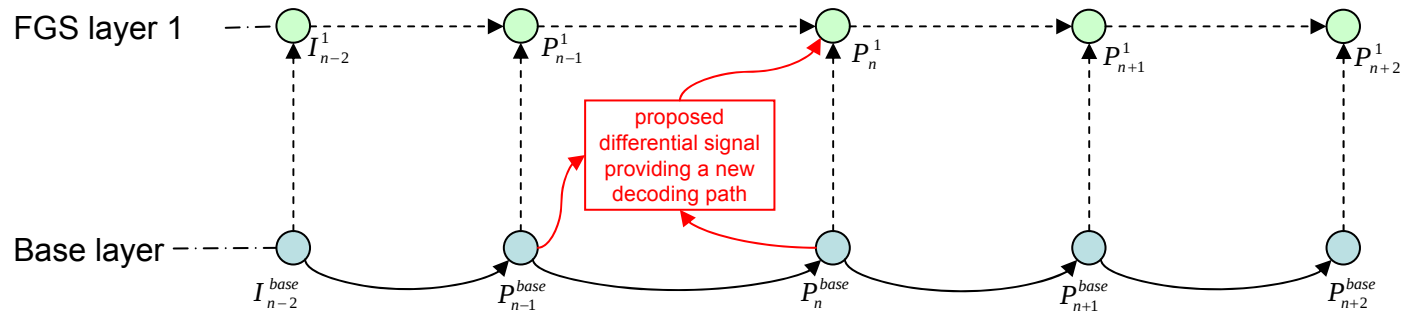
- FGS switching slices implemented in the JSVM_5_8
- Testing conditions conforming to JVT-Q307 (Former CE on improved and low delay FGS)
 - Single FGS layer coding tests
 - Test sequences
 - bus/foreman/football/mobile CIF sequences at 15 FPS
 - city/crew/harbour/soccer 4CIF sequences 30 FPS
 - For each sequence, each frame is coded as a closed-loop P frame, except for the first intra frame.
 - Base layer QP = 38
 - Repeat the experiments using base layer QP of 30.
 - Decode the bitstream at 10% bit rate increment starting from the base layer.
 - Two FGS layers coding tests
 - Test sequences:
 - bus/foreman/football/mobile CIF sequences at 15 FPS
 - city/crew/harbour/soccer 4CIF sequences 30 FPS
 - Coding structure as specified in JVT-P205 as well as IPPP...
 - Closed-loop encoder control
 - Base layer QP = 46 for GOP structures
 - Base layer QP = 38 for IPPP... coding
 - Decode the bitstream at 10% bit rate increment starting from the base layer.

Insertion of switching FGS slices

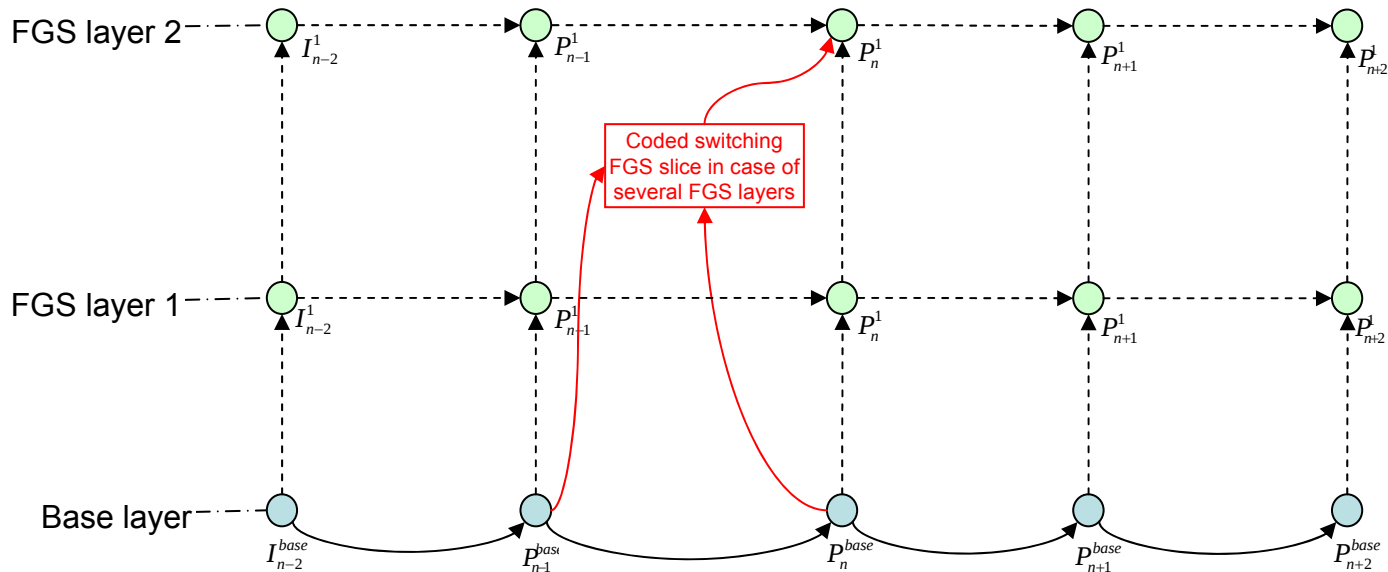
- IPPP... coding structure:
 - 1 switching FGS slice is inserted every 16 picture, starting from the second P picture.
- GOP structure coding (as defined in JVT-P205):
 - 1 switching FGS slice inserted for every two P pictures for CIF sequence, starting from the second P picture.
 - 1 switching FGS slice coded for every 4 P pictures for 4CIF pictures
- Each coded switching slice allows switching from the base layer reference picture towards the highest FGS layer

Insertion of switching FGS slices

- One FGS layer:

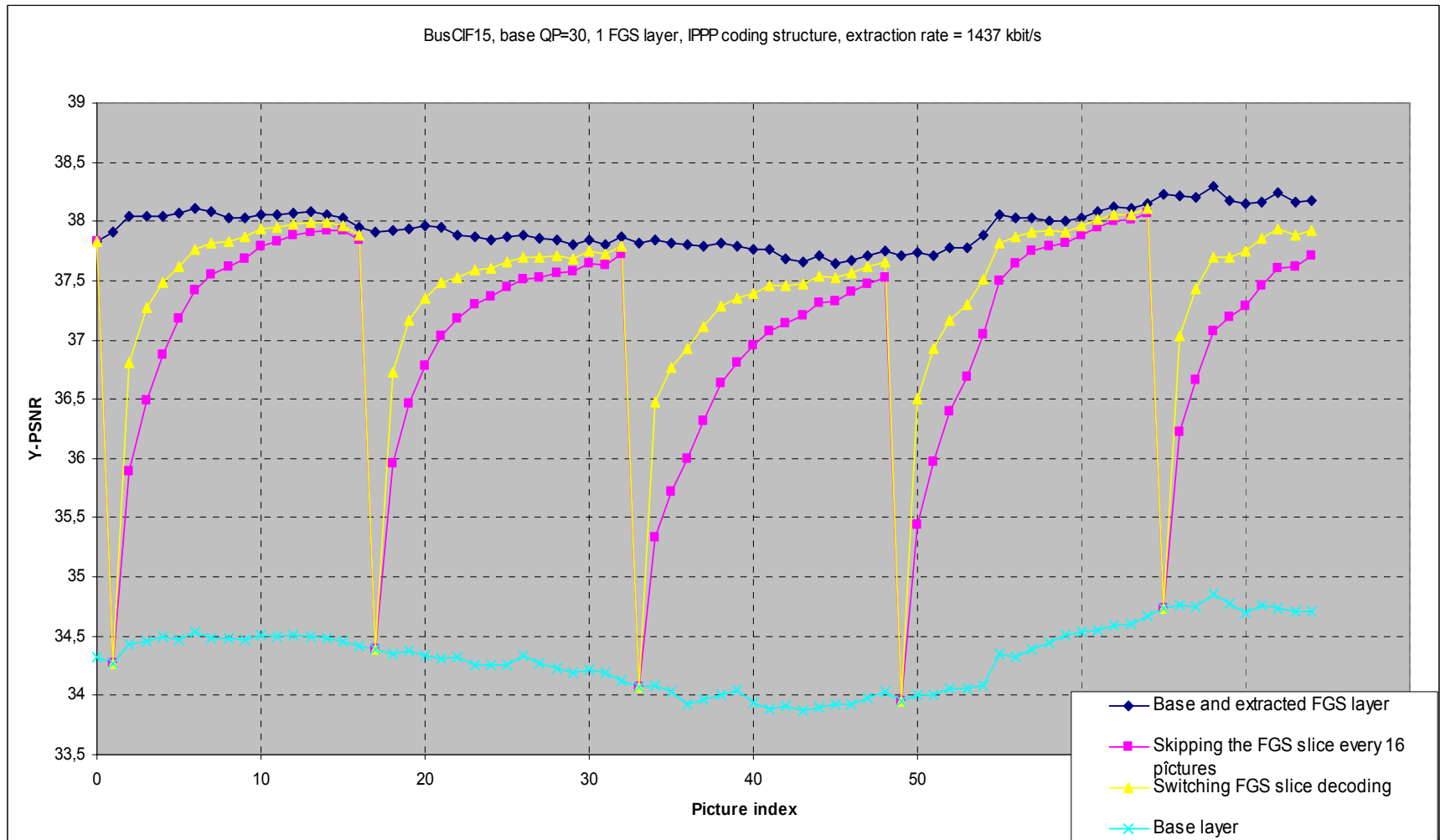


- Two FGS layers:



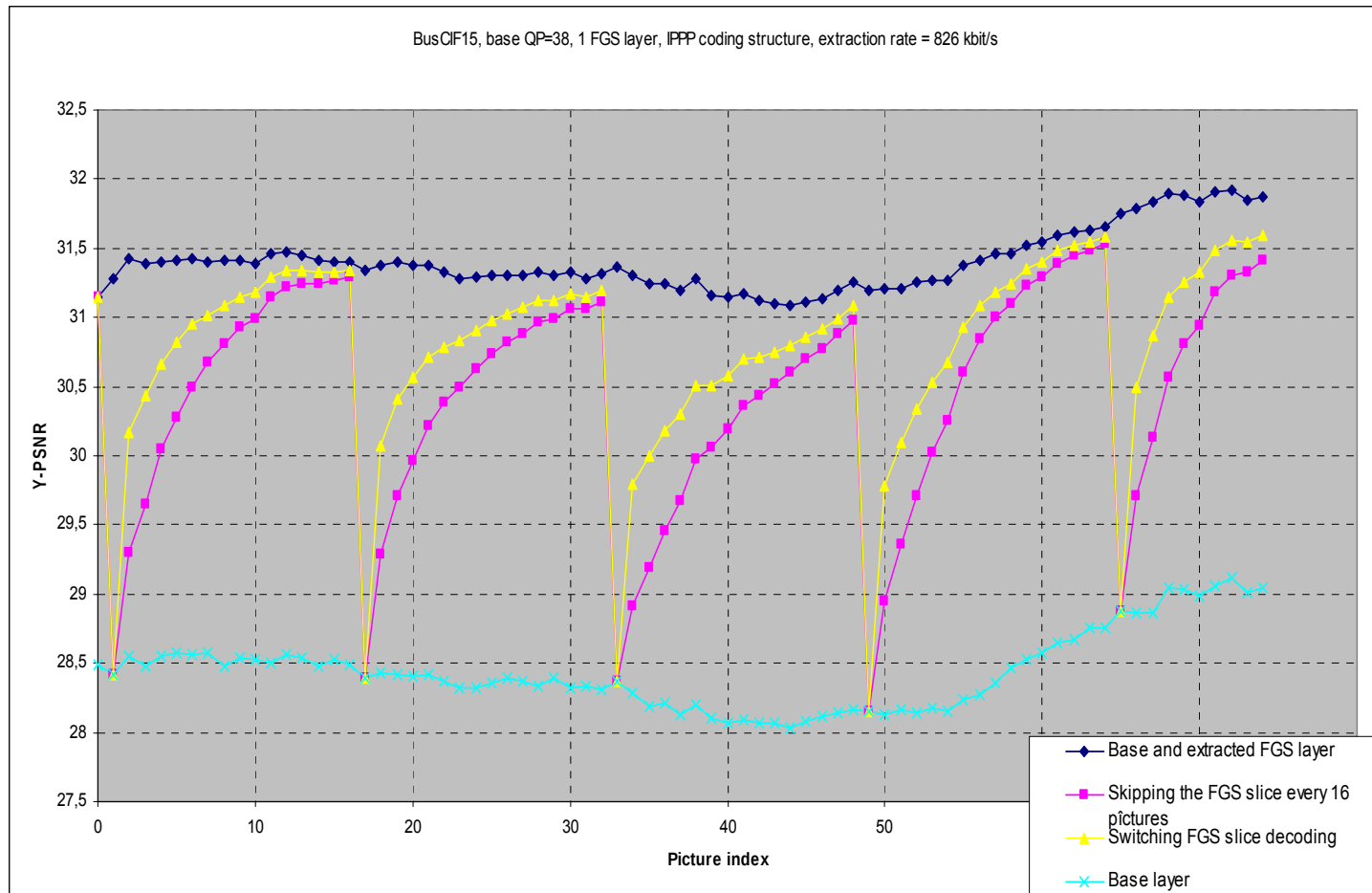
First results: decoder refreshing capacity

- AR-FGS used with weighting factors $\alpha=2$ and $\beta=14$
- BusCIF15, base QP=30, 1 FGS layer, IPPP coding structure, rate=1437kbit/s



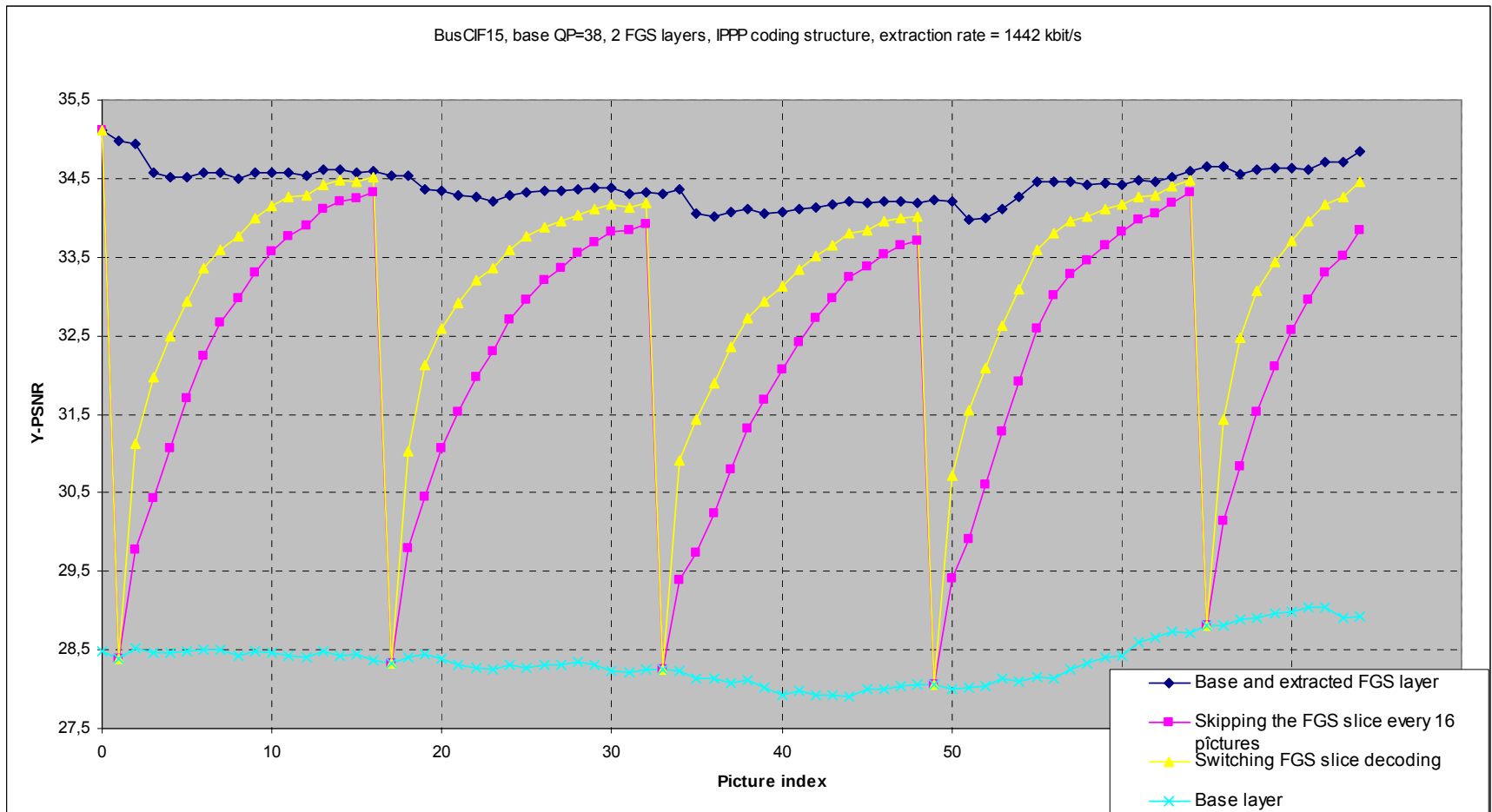
First results: decoder refreshing ability

- AR-FGS used with weighting factors $\alpha=2$ and $\beta=14$
- BusCIF15, base QP=38, 1 FGS layer, IPPP coding structure, rate=826kbit/s



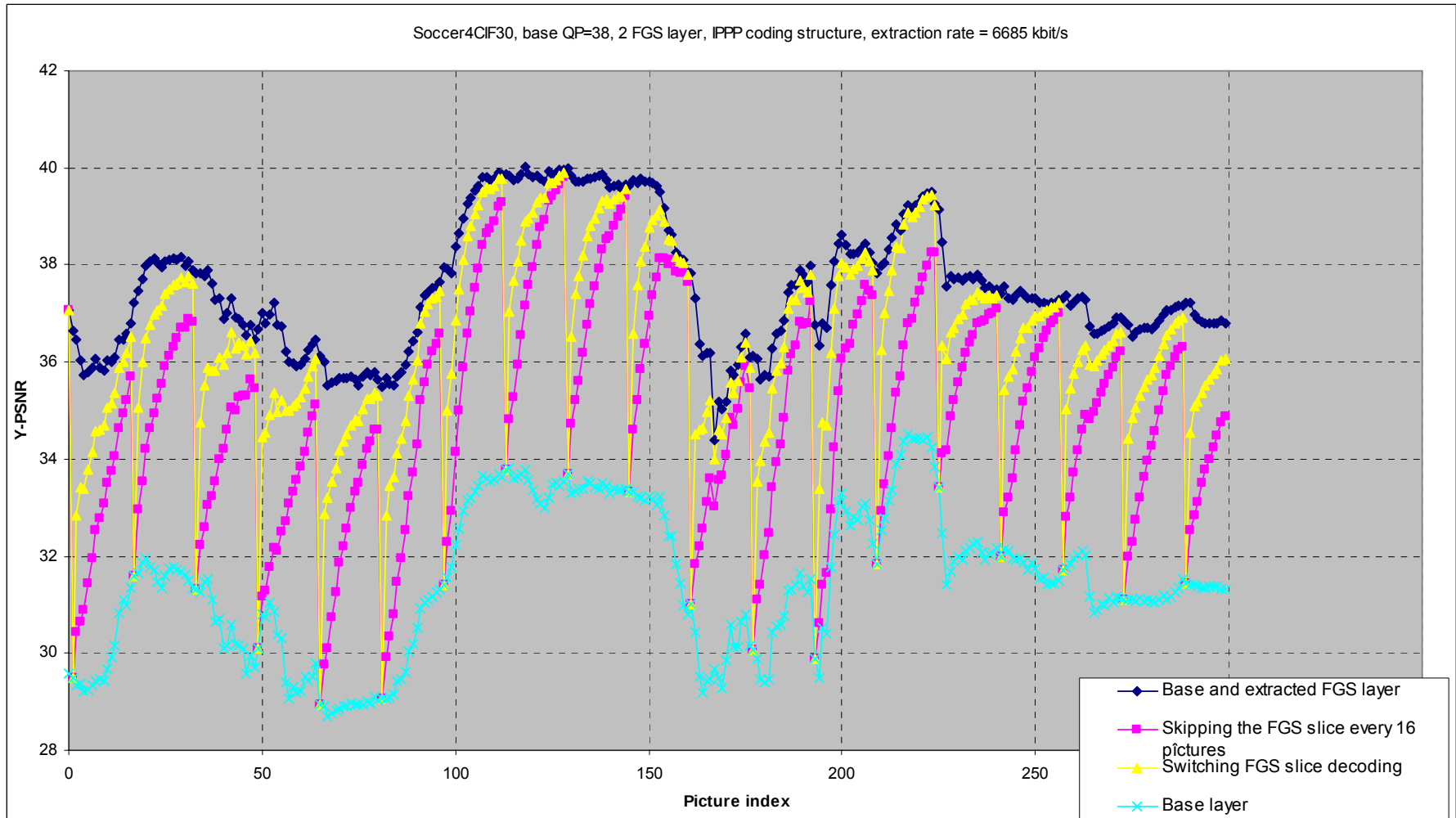
First results: decoder refreshing ability

- AR-FGS used with weighting factors $\alpha=2$ and $\beta=14$
- BusCIF15, base QP=38, 2 FGS layers, IPPP coding structure, rate=1442kbit/s



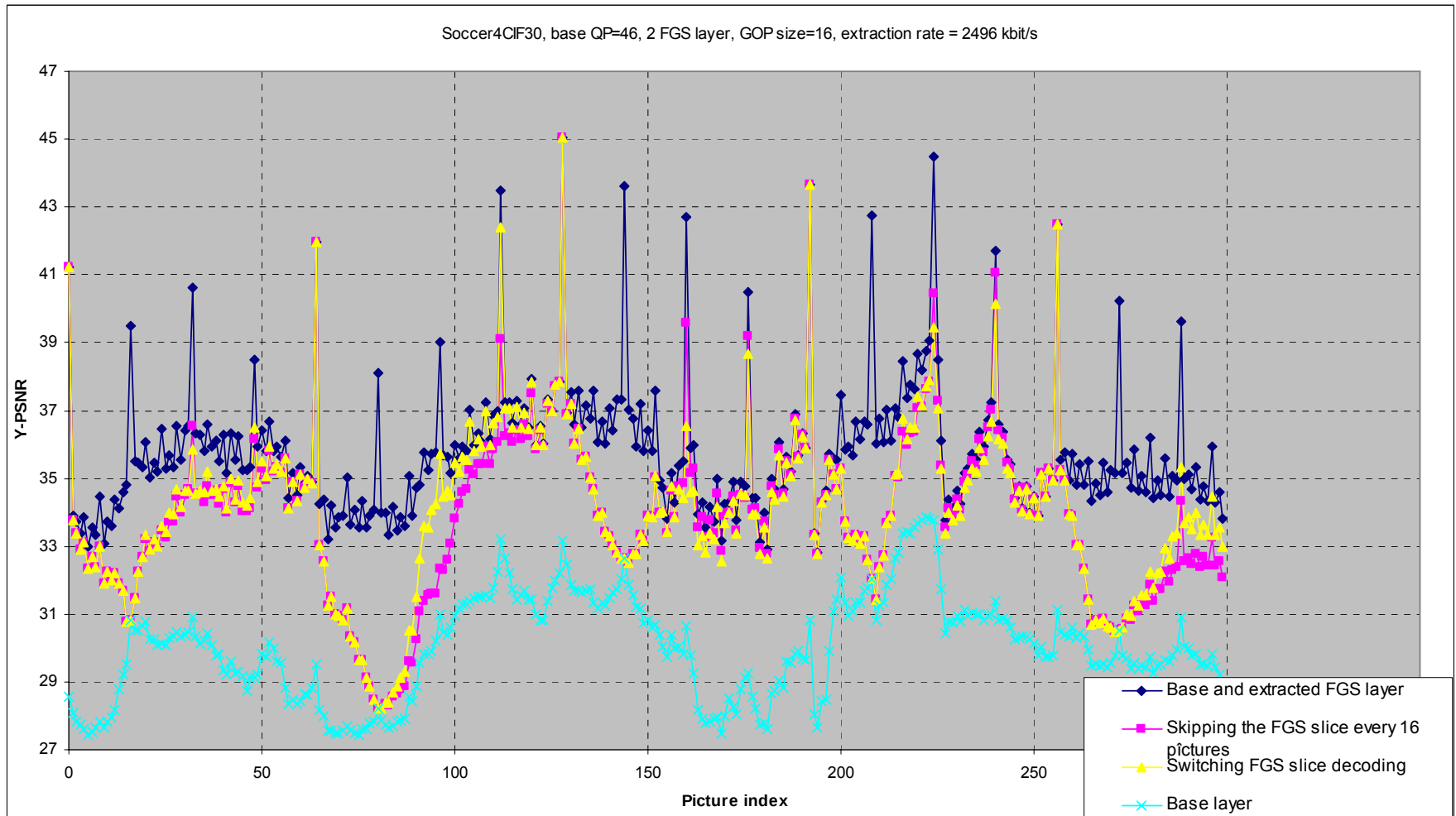
First results: decoder refreshing ability

- AR-FGS used with weighting factors $\alpha=2$ and $\beta=14$
- Soccer4CIF30, base QP=38, 2 FGS layers, IPPP coding structure, rate=6685kbit/s



First results: decoder refreshing ability

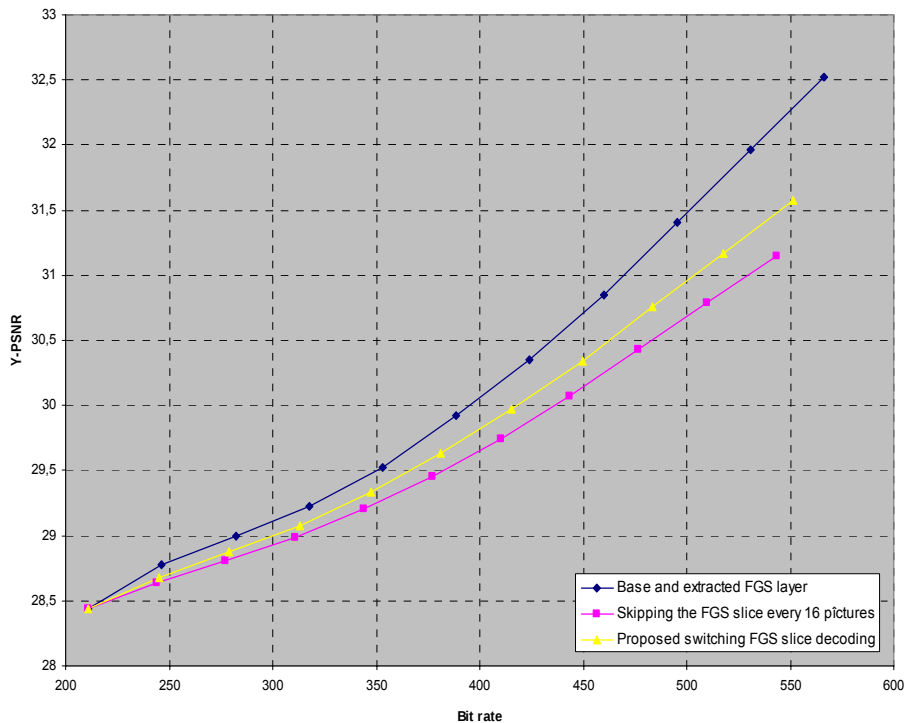
- AR-FGS used with weighting factors $\alpha=2$ and $\beta=14$
- Soccer4CIF30, base QP=46, 2 FGS layers, GOP coding structure, rate=2496kbit/s



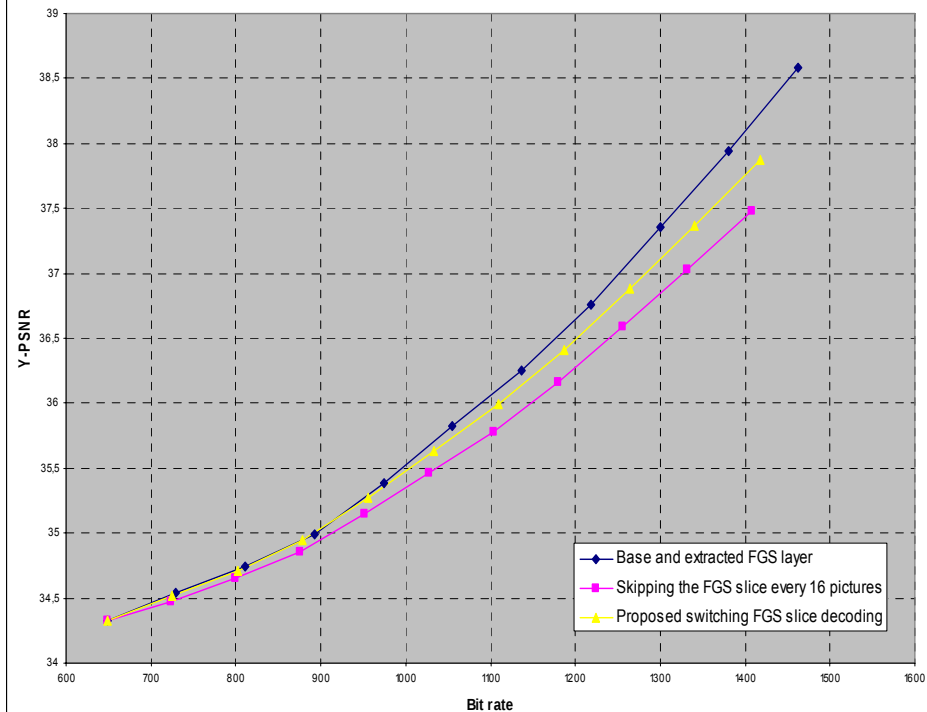
Exhaustive results: avg. PSNR vs. bitrate

- BusCIF15, 1 FGS layer, IPPP coding structure
 - Base QP=38 (left)
 - Base QP=30 (right)

BusCIF15, base QP=38, 1 FGS layer, IPPP coding structure



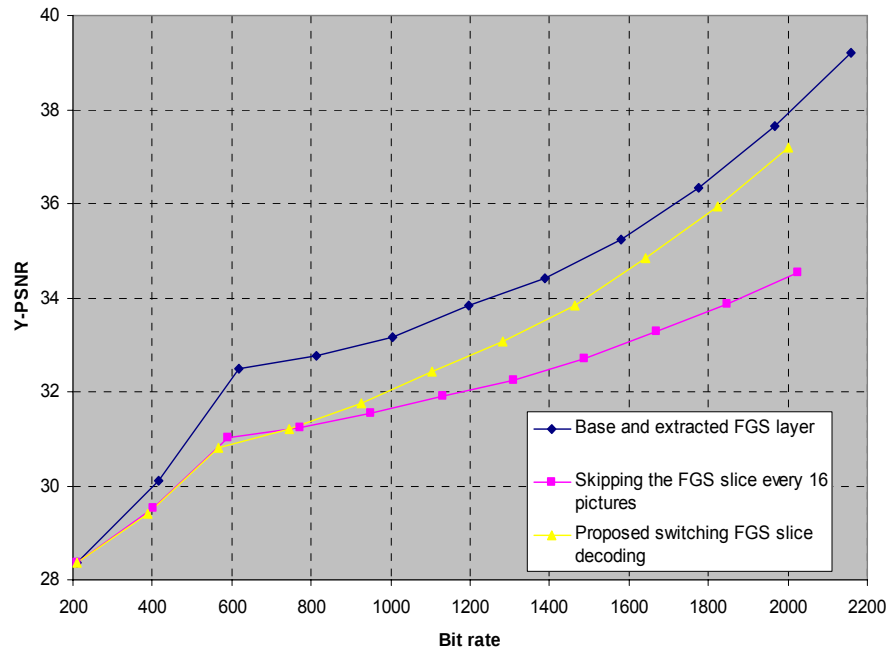
BusCIF15, base QP=30, 1 FGS layer, IPPP coding structure



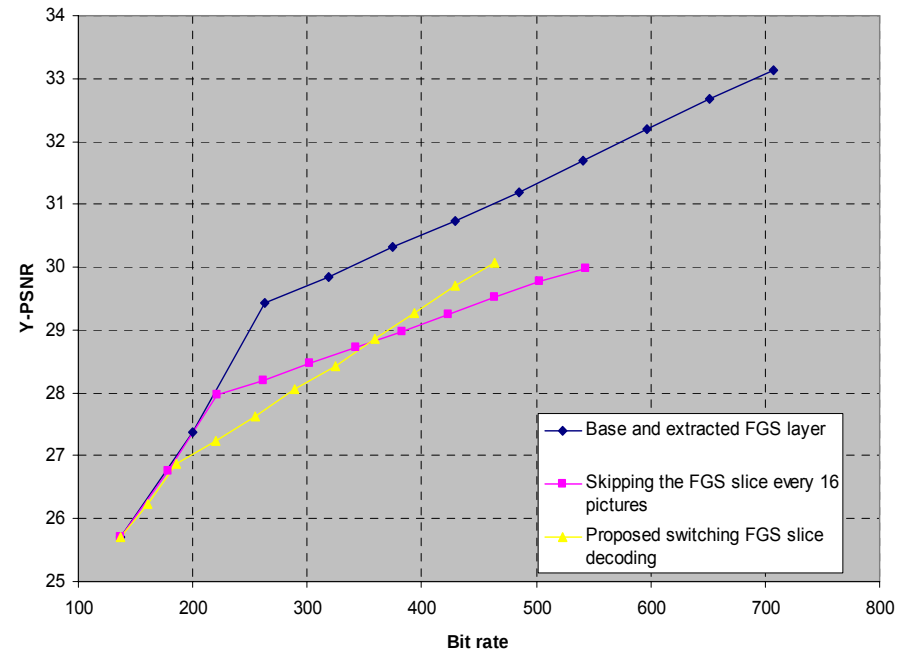
Exhaustive results: avg. PSNR vs. bitrate

- BusCIF15, 2 FGS layers
 - IPPP coding structure, base QP=38 (left)
 - GOP coding structure, base QP=46 (right)

BusCIF15, base QP=38, 2 FGS layers, IPPP coding structure

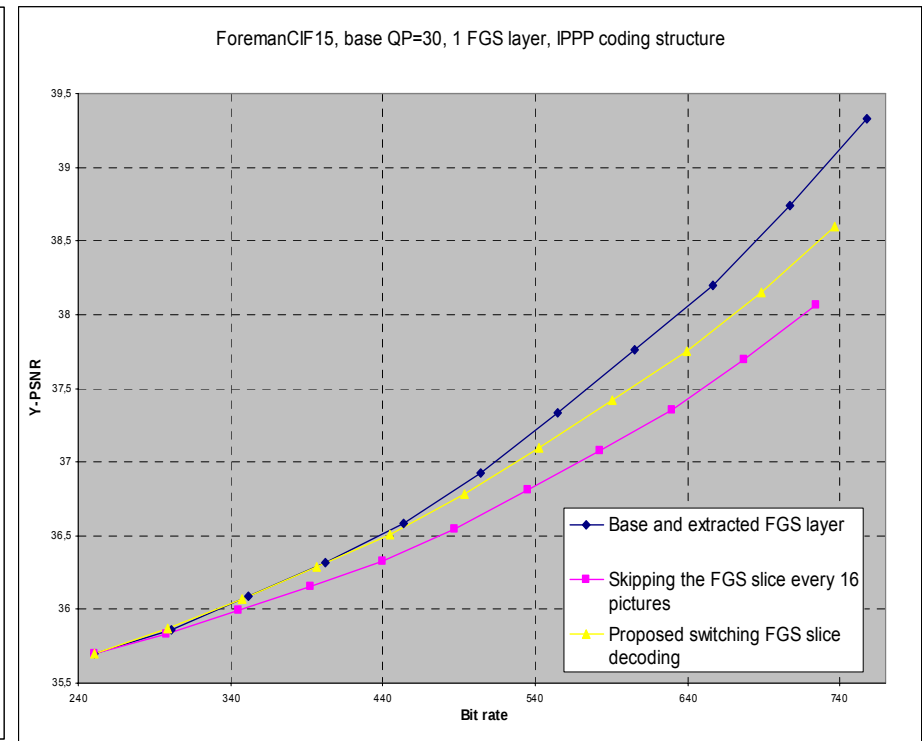
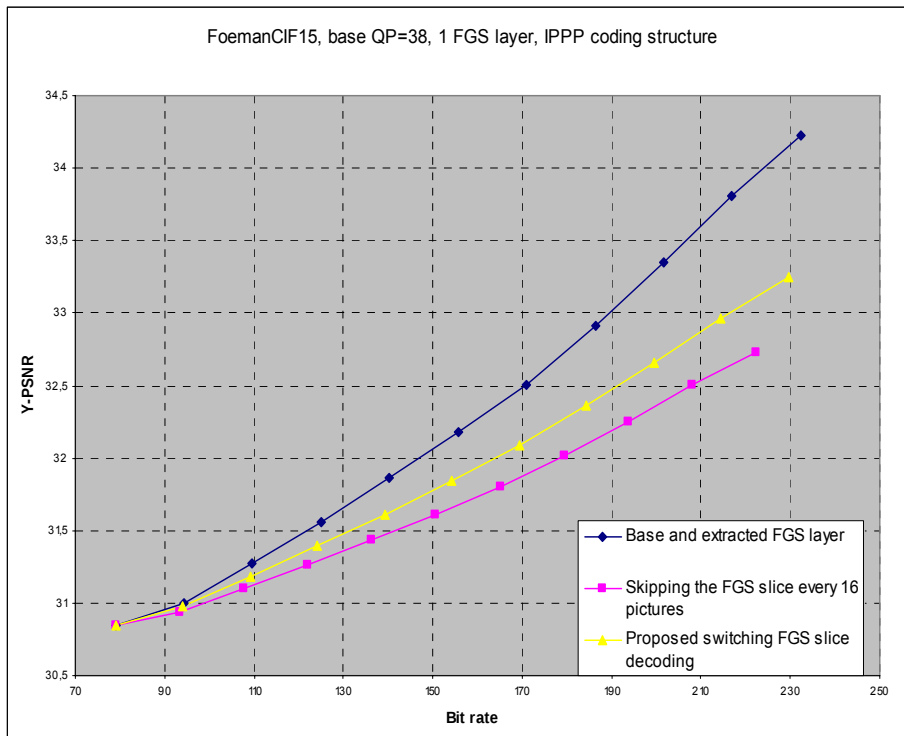


BusCIF15, base QP=46, 2 FGS layers, GOP coding structure



Exhaustive results: avg. PSNR vs. bitrate

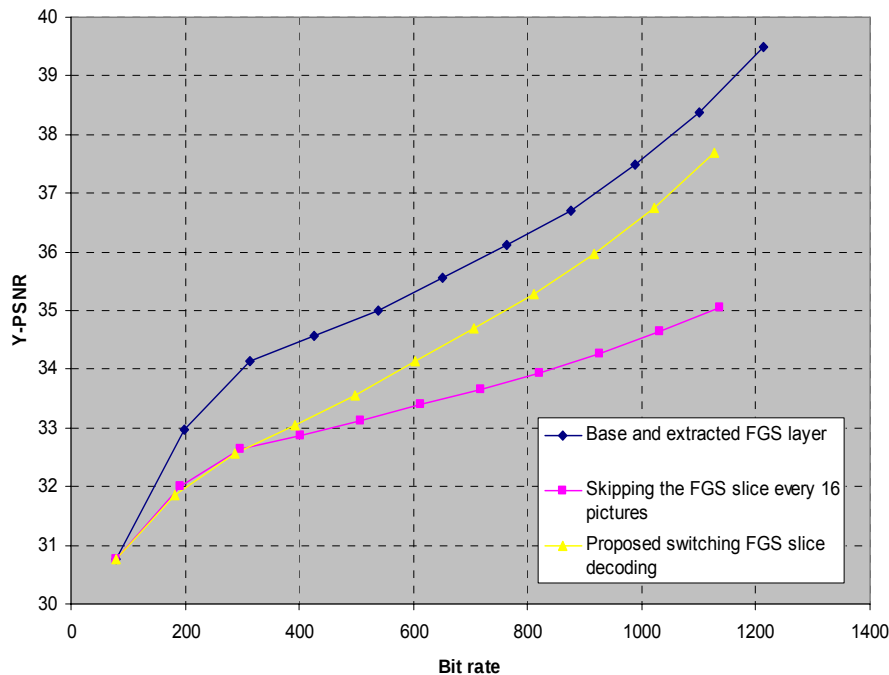
- ForemanCIF15, 1 FGS layer, IPPP coding structure
 - Base QP=38 (left)
 - Base QP=30 (right)



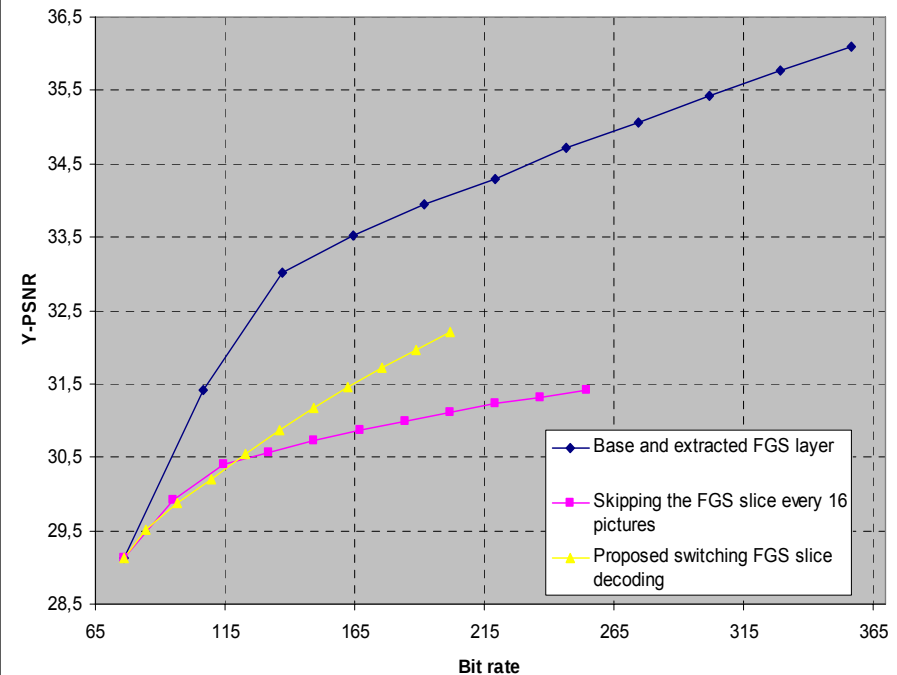
Exhaustive results: avg. PSNR vs. bitrate

- ForemanCIF15, 2 FGS layers
 - IPPP coding structure, base QP=38 (left)
 - GOP coding structure, base QP=46 (right)

ForemanCIF15, base QP=38, 2 FGS layers, IPPP coding structure



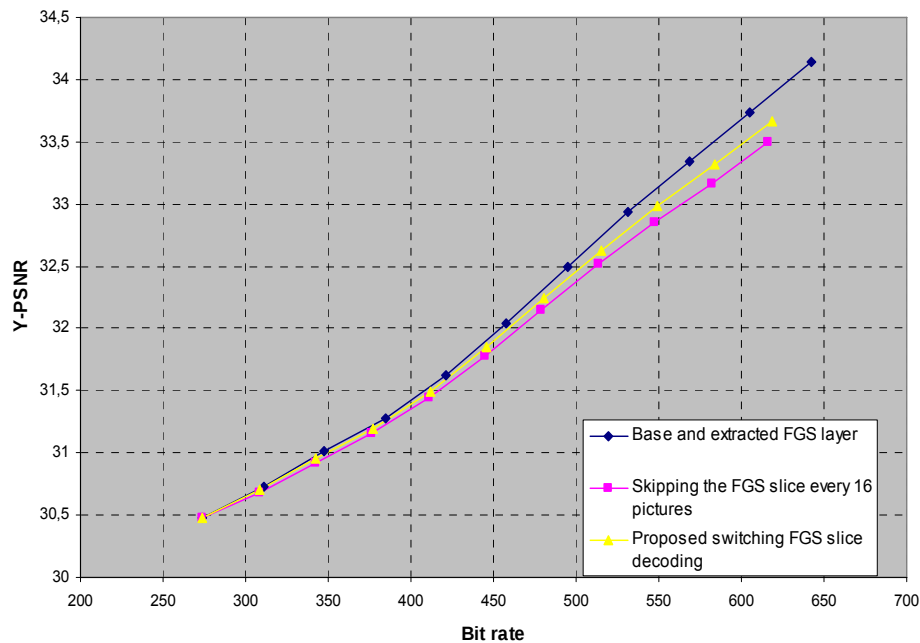
ForemanCIF15, base QP=46, 2 FGS layers, GOP coding structure



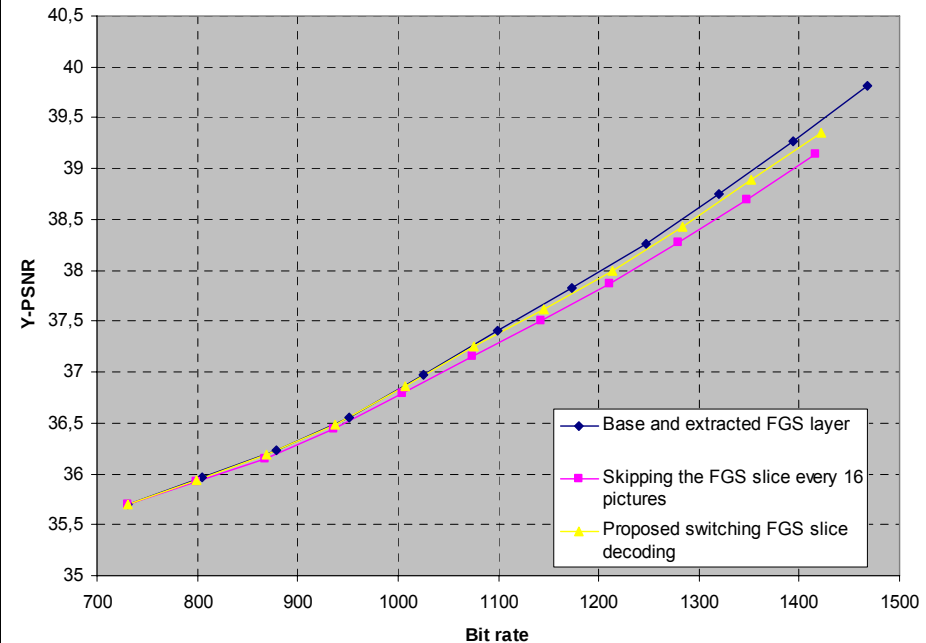
Exhaustive results: avg. PSNR vs. bitrate

- FootballCIF15, 1 FGS layer, IPPP coding structure
 - Base QP=38 (left)
 - Base QP=30 (right)

Football CIF15, base QP=38, 1 FGS layer, IPPP coding structure



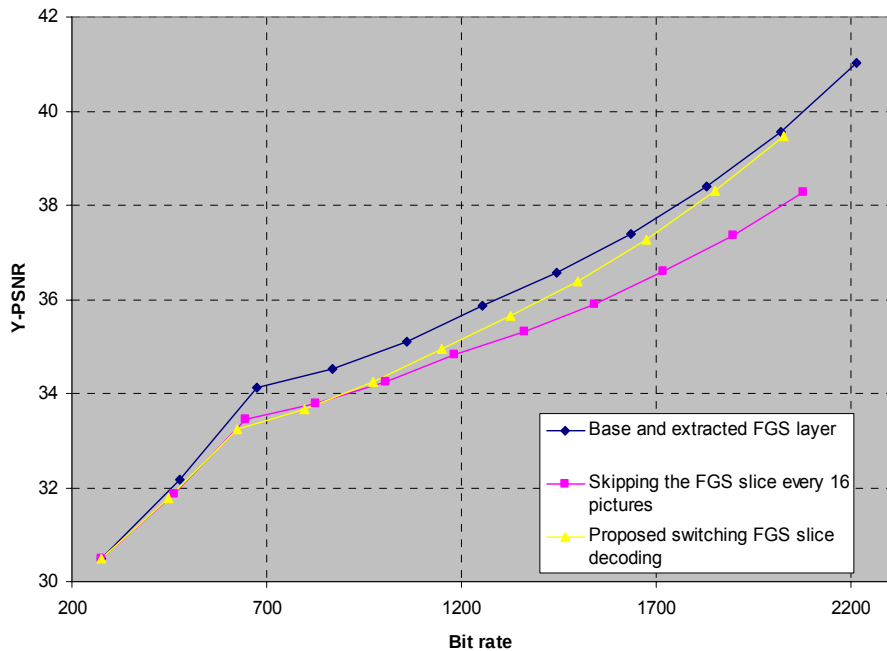
Football CIF15, base QP=30, 1 FGS layer, IPPP coding structure



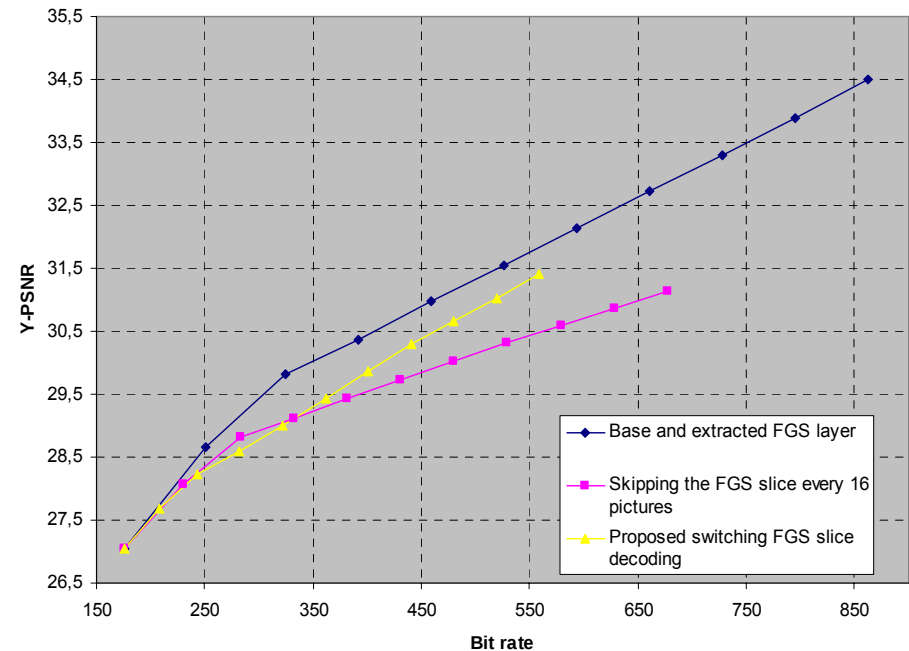
Exhaustive results: avg. PSNR vs. bitrate

- FootballCIF15, 2 FGS layers
 - IPPP coding structure, base QP=38 (left)
 - GOP coding structure, base QP=46 (right)

Football CIF15, base QP=38, 2 FGS layers, IPPP coding structure



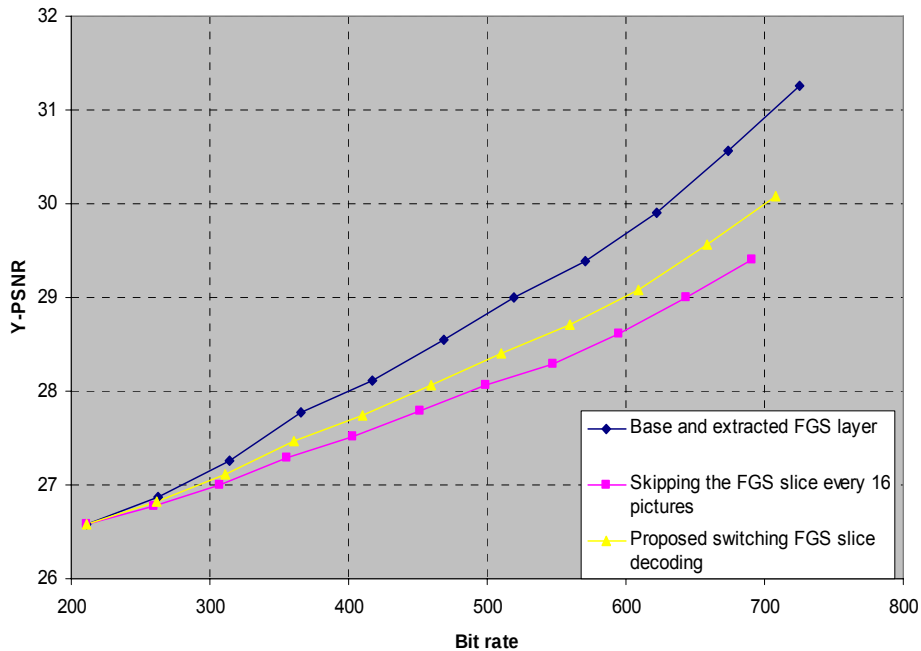
FootballCIF15, base QP=46, 2 FGS layers, GOP coding structure



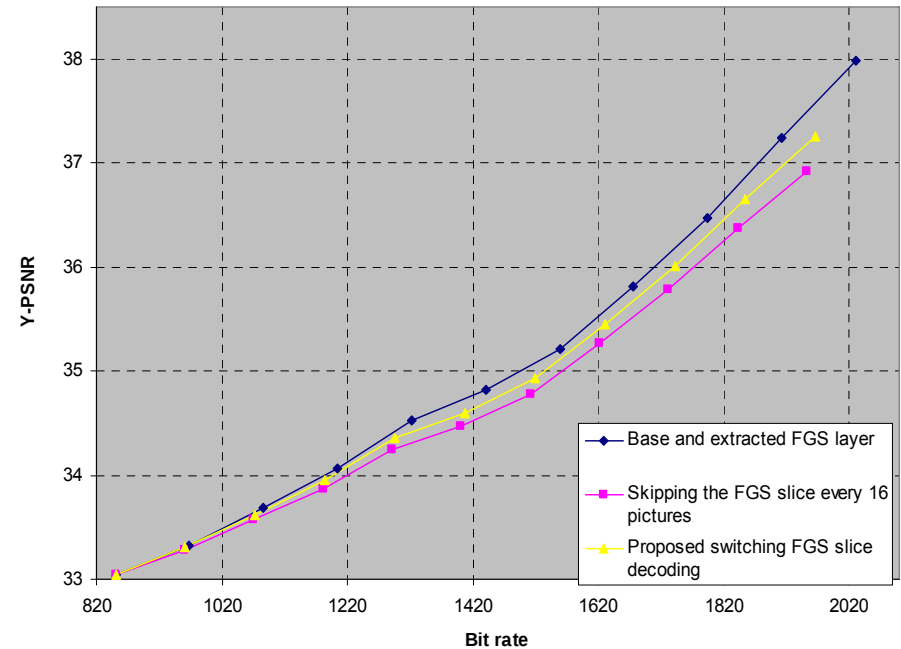
Exhaustive results: avg. PSNR vs. bitrate

- MobileCIF15, 1 FGS layer, IPPP coding structure
 - Base QP=38 (left)
 - Base QP=30 (right)

MobileCIF15, base QP=38, 1 FGS layer, IPPP coding structure



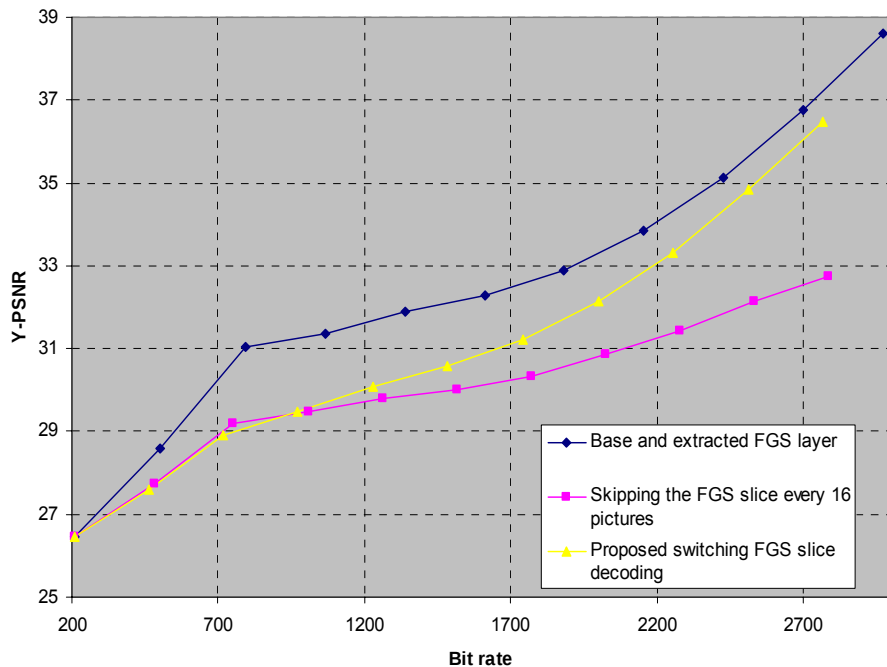
MobileCIF15, base QP=30, 1 FGS layer, IPPP coding structure



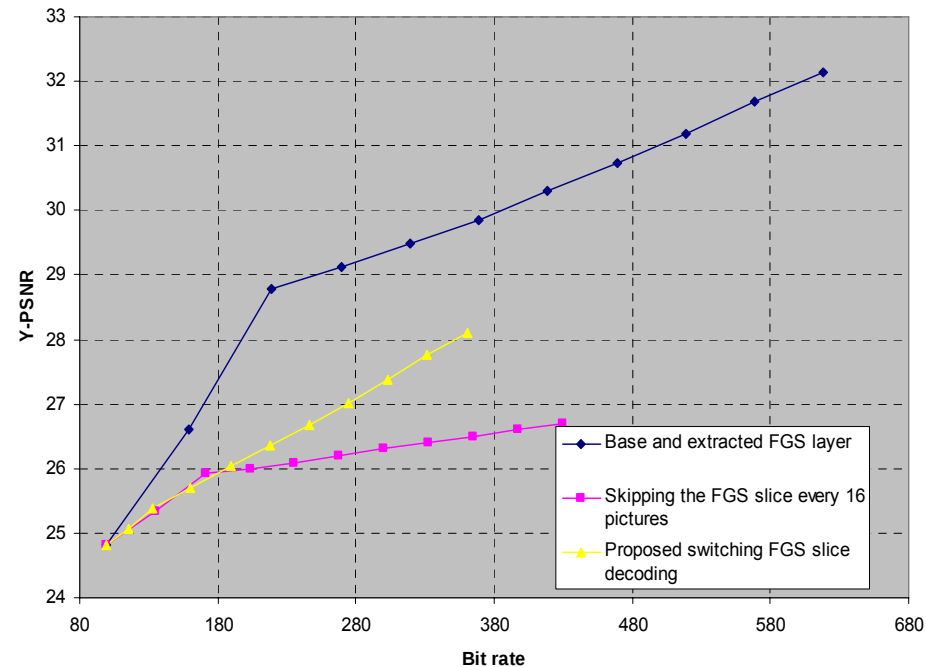
Exhaustive results: avg. PSNR vs. bitrate

- MobileCIF15, 2 FGS layers
 - IPPP coding structure, base QP=38 (left)
 - GOP coding structure, base QP=46 (right)

MobileCIF15, base QP=38, 2 FGS layers, IPPP coding structure



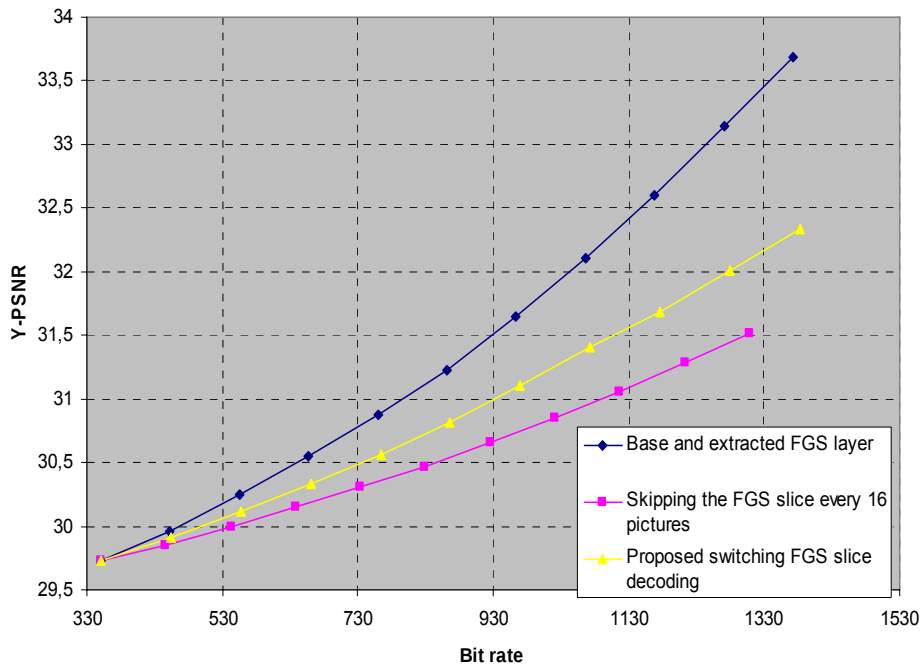
MobileCIF15, base QP=46, 2 FGS layers, GOP coding structure



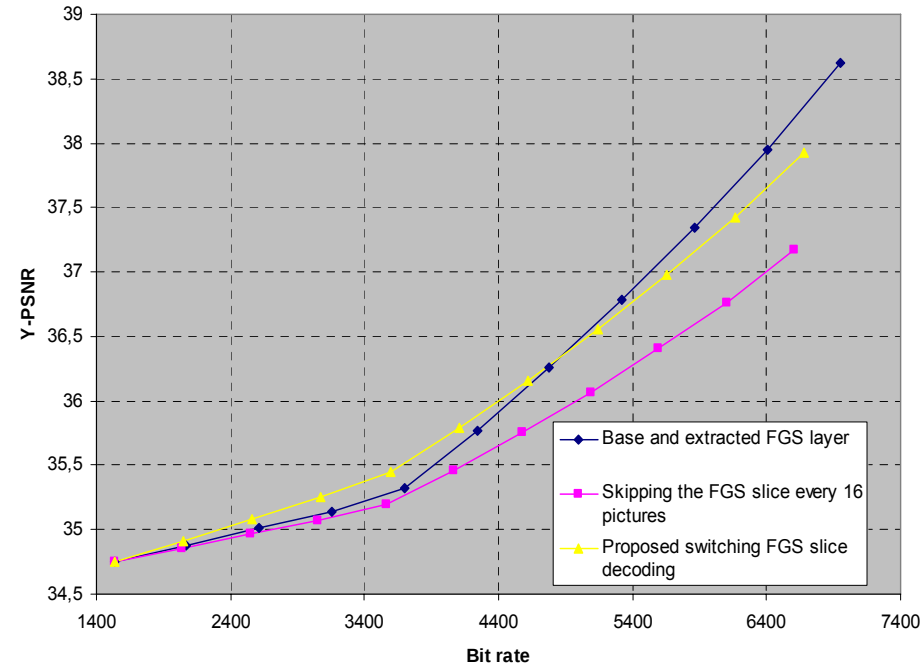
Exhaustive results: avg. PSNR vs. bitrate

- City4CIF30, 1 FGS layer, IPPP coding structure
 - Base QP=38 (left)
 - Base QP=30 (right)

City4CIF30, base QP=38, 1 FGS layer, IPPP coding structure



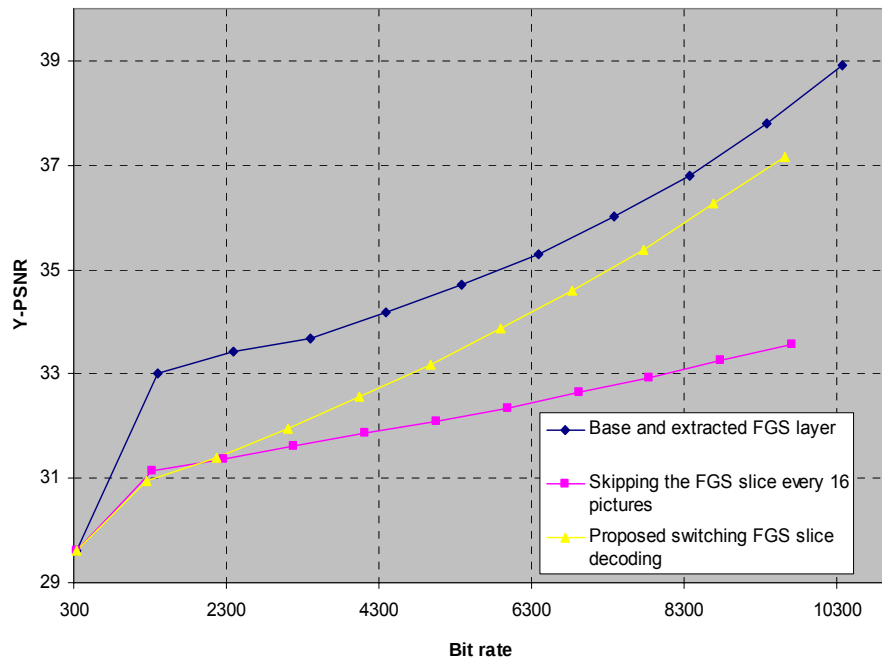
City4CIF30, base QP=30, 1 FGS layer, IPPP coding structure



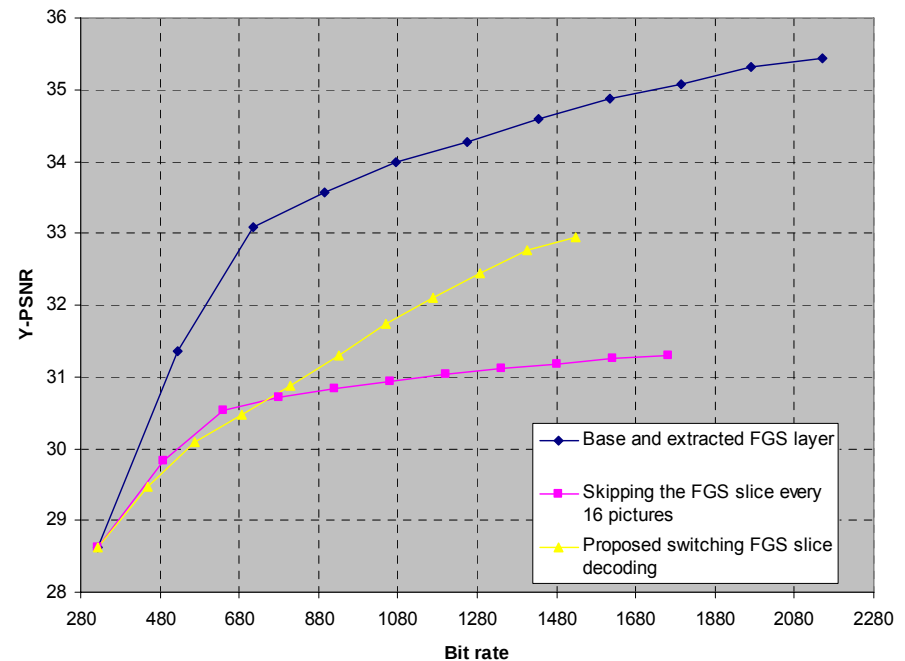
Exhaustive results: avg. PSNR vs. bitrate

- City4CIF30, 2 FGS layers
 - IPPP coding structure, base QP=38 (left)
 - GOP coding structure, base QP=46 (right)

City4CIF30, base QP=38, 2 FGS layers, IPPP coding structure



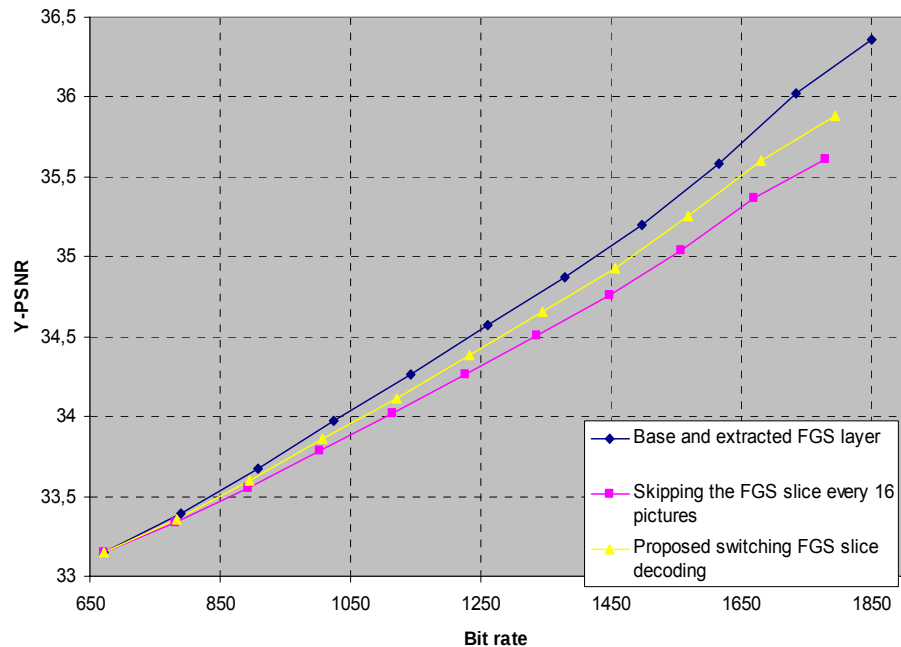
City4CIF30, base QP=46, 2 FGS layers, GOP coding structure



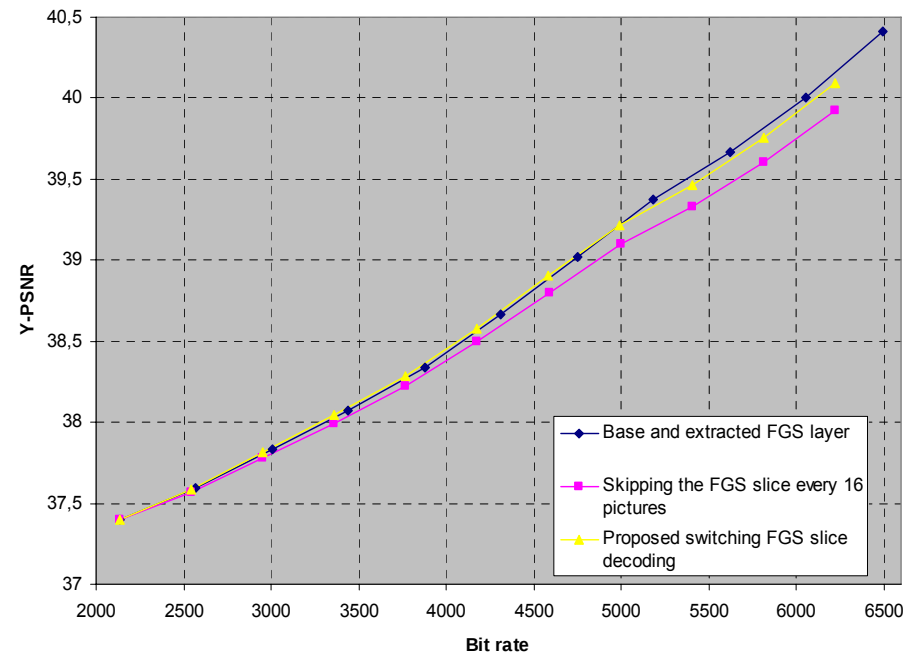
Exhaustive results: avg. PSNR vs. bitrate

- Crew4CIF30, 1 FGS layer, IPPP coding structure
 - Base QP=38 (left)
 - Base QP=30 (right)

Crew4CIF30, base QP=38, 1 FGS layer, IPPP coding structure



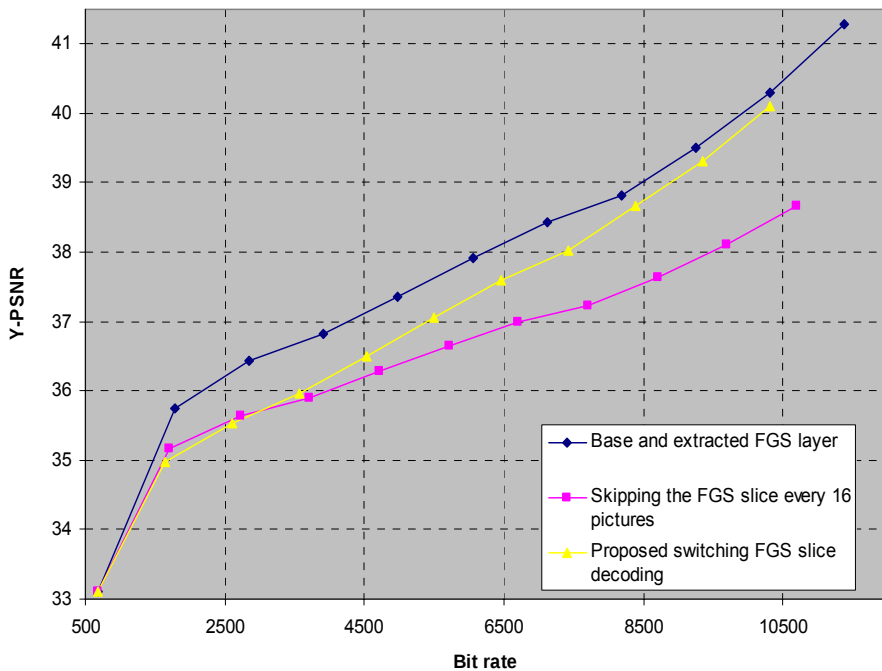
Crew4CIF30, base QP=30, 1 FGS layer, IPPP coding structure



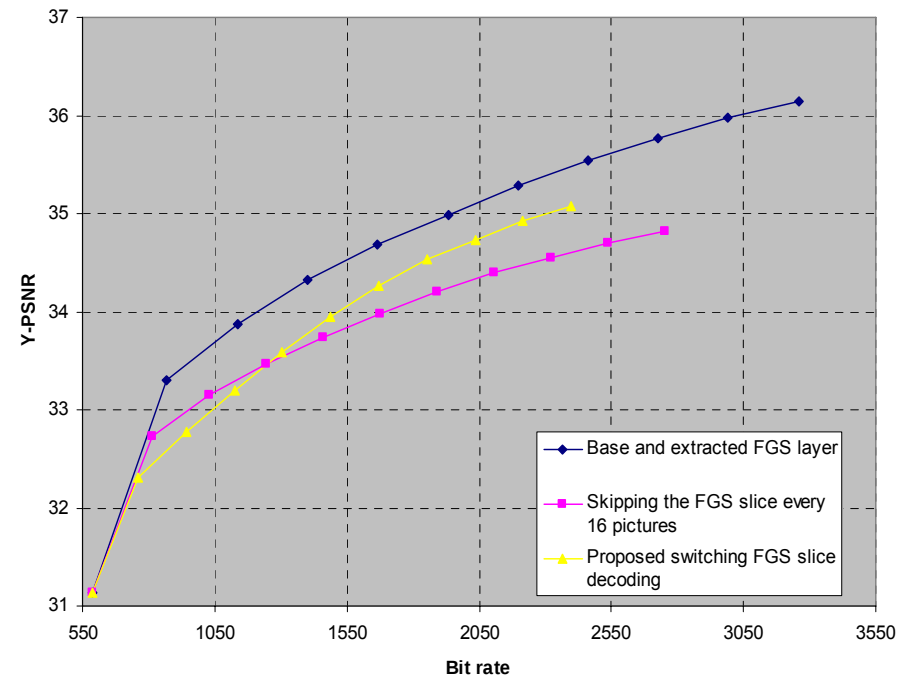
Exhaustive results: avg. PSNR vs. bitrate

- Crew4CIF30, 2 FGS layers
 - IPPP coding structure, base QP=38 (left)
 - GOP coding structure, base QP=46 (right)

Crew4CIF30, base QP=38, 2 FGS layers, IPPP coding structure

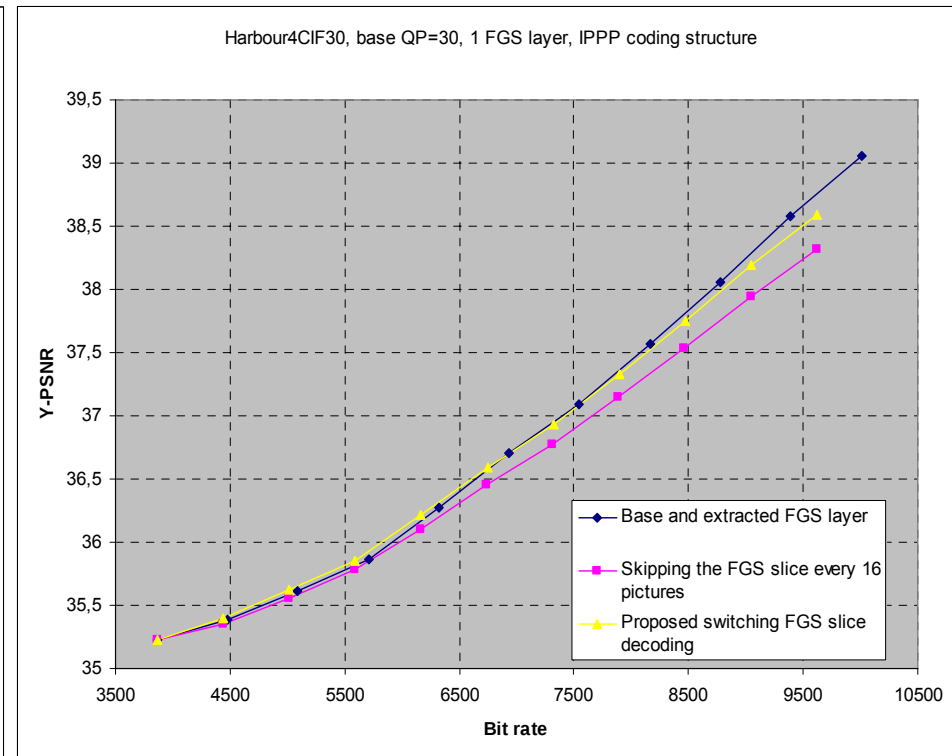
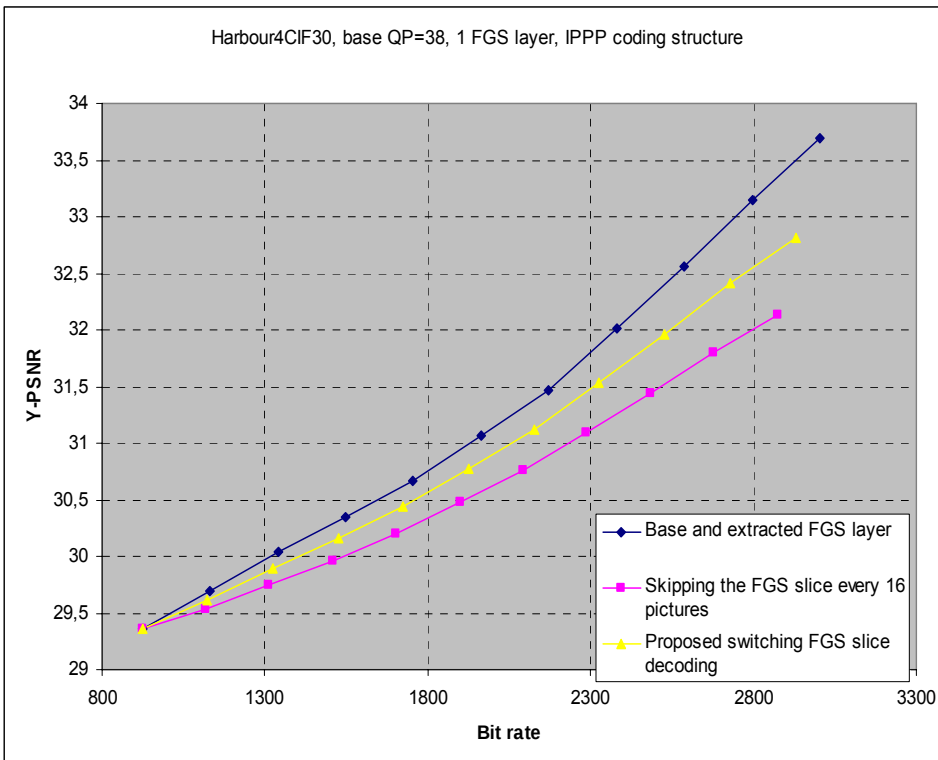


Crew4CIF30, base QP=46, 2 FGS layers, GOP coding structure



Exhaustive results: avg. PSNR vs. bitrate

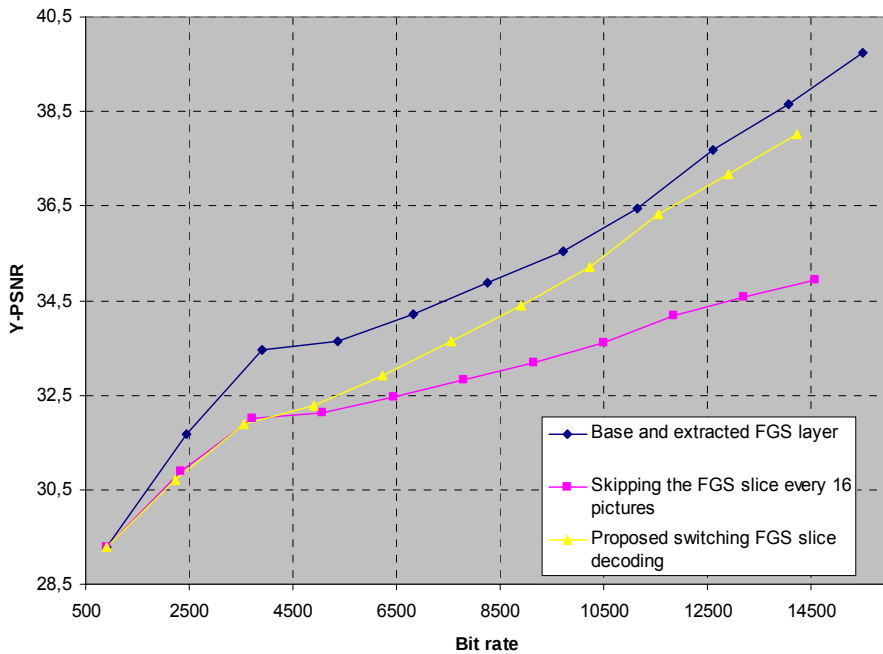
- Harbour4CIF30, 1 FGS layer, IPPP coding structure
 - Base QP=38 (left)
 - Base QP=30 (right)



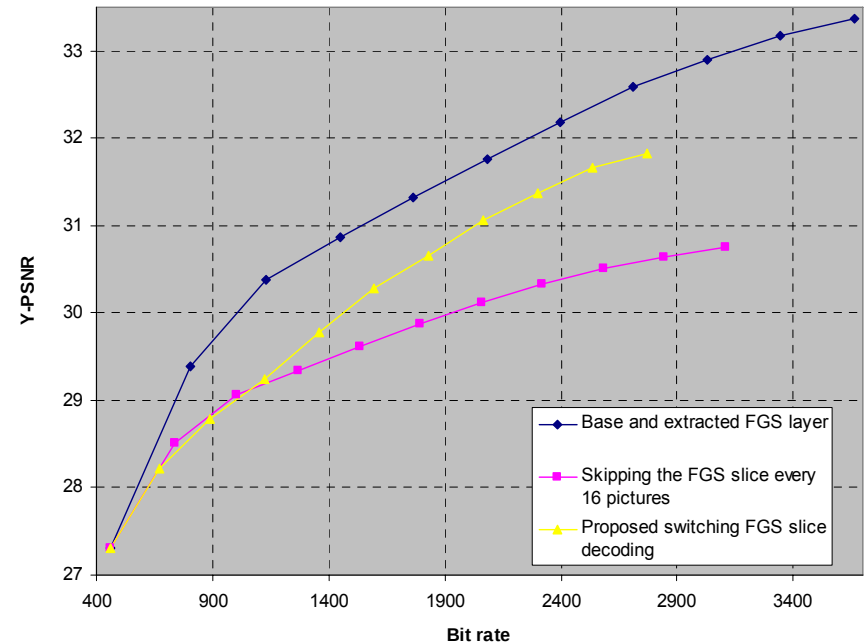
Exhaustive results: avg. PSNR vs. bitrate

- Harbour4CIF30, 2 FGS layers
 - IPPP coding structure, base QP=38 (left)
 - GOP coding structure, base QP=46 (right)

Harbour4CIF30, base QP=38, 2 FGS layers, IPPP coding structure



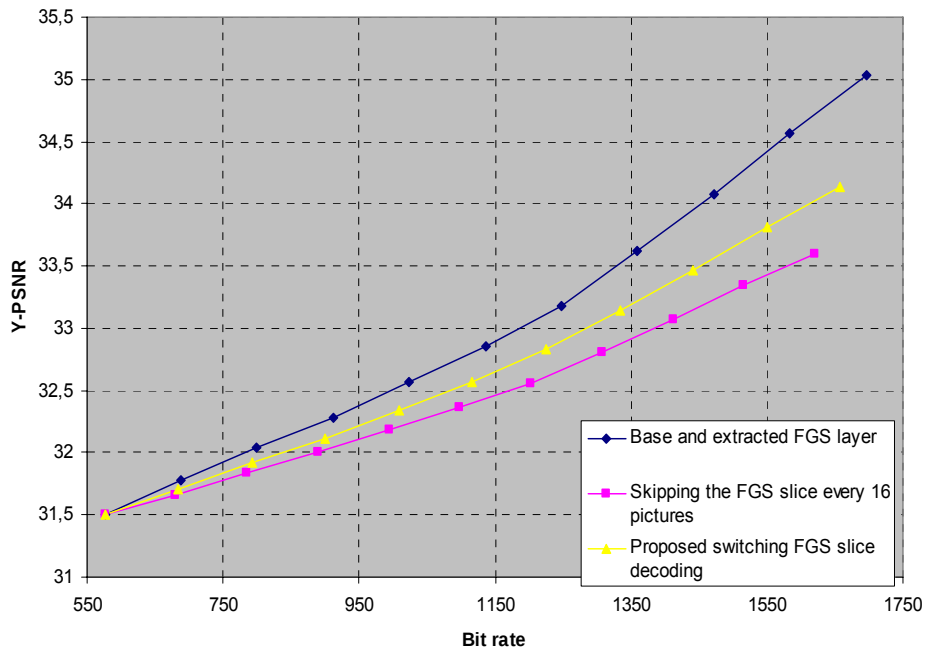
Harbour4CIF30, base QP=46, 2 FGS layers, GOP coding structure



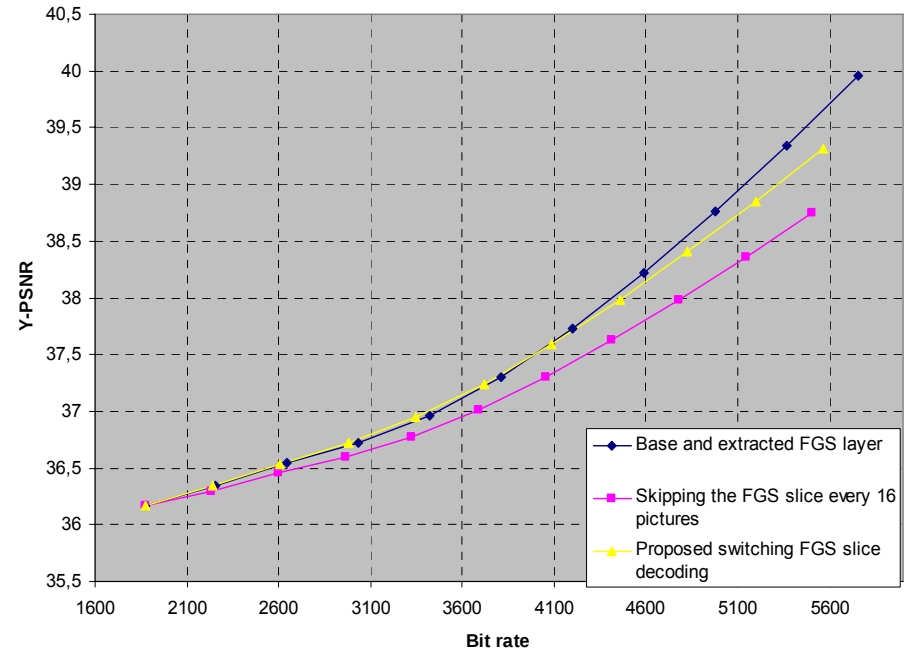
Exhaustive results: avg. PSNR vs. bitrate

- Soccer4CIF30, 1 FGS layer, IPPP coding structure
 - Base QP=38 (left)
 - Base QP=30 (right)

Soccer4CIF30, base QP=38, 1 FGS layer, IPPP coding structure



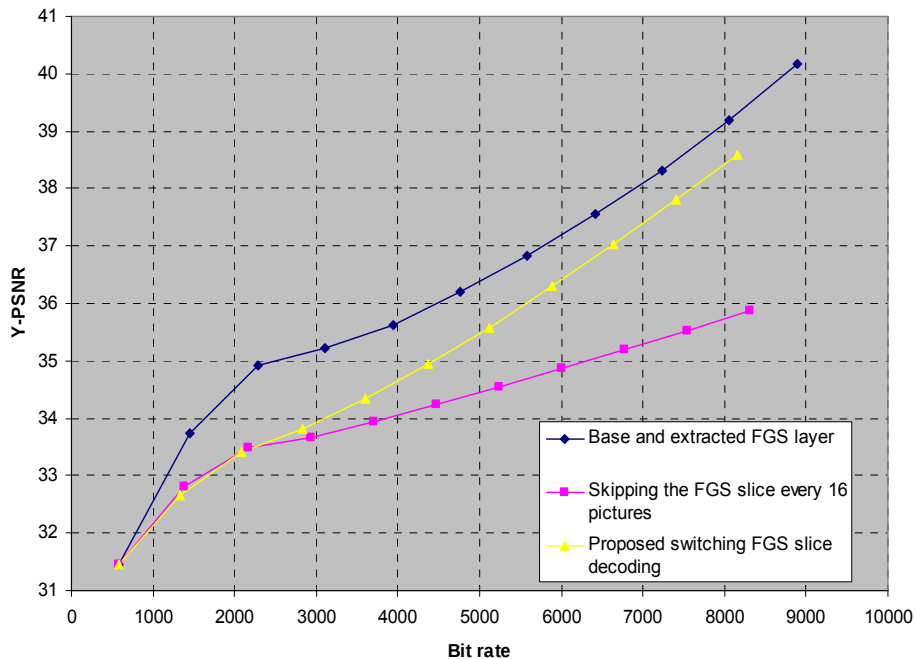
Soccer4CIF30, base QP=30, 1 FGS layer, IPPP coding structure



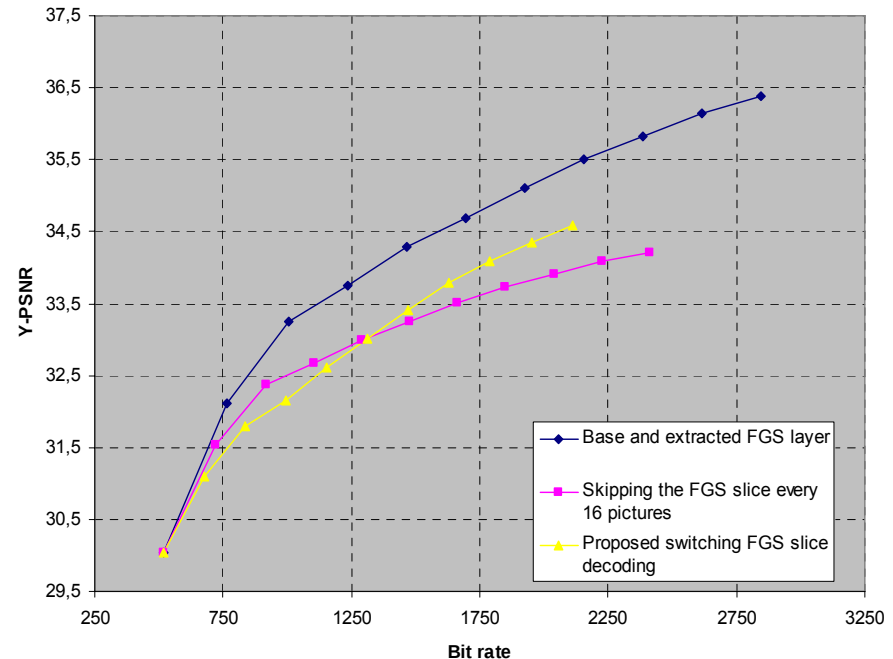
Exhaustive results: avg. PSNR vs. bitrate

- Soccer4CIF30, 2 FGS layers
 - IPPP coding structure, base QP=38 (left)
 - GOP coding structure, base QP=46 (right)

Soccer4CIF30, base QP=38, 2 FGS layers, IPPP coding structure



Soccer4CIF30, base QP=46, 2 FGS layers, GOP coding structure



Conclusion

- New tool proposed to insert FGS switching data:
 - Enabling to switch up between FGS layers
 - Reduced drift + good coding efficiency
 - Improvement especially in the low-delay mode
 - Typically: up to 0.5dB gain with 1 FGS layer, base QP=30
 - Up to 3dB gain with 2 FGS layers (IPPP coding structure)
 - Only transmitted to a client when increasing the FGS rate from a level to a higher one
 - Possible error resilience tool: applicable for loss recovery purposes
 - Little change in the syntax (1 additional slice type)