Slice Groups for Post-Compression Region of Interest Encryption in SVC

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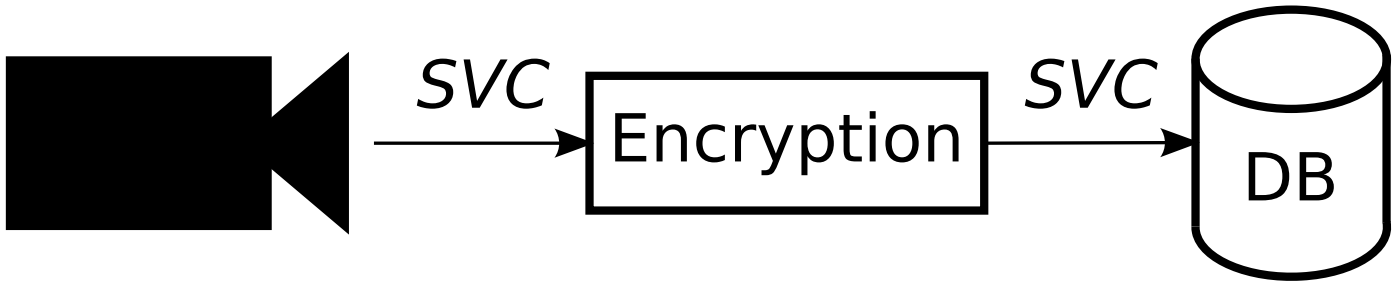
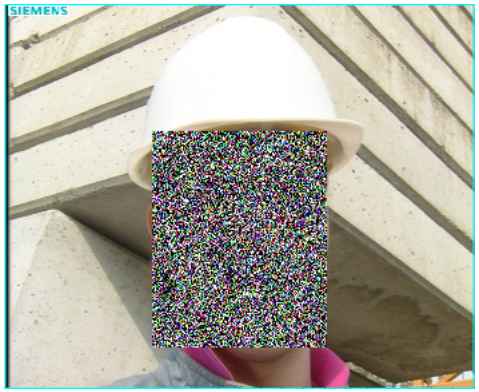
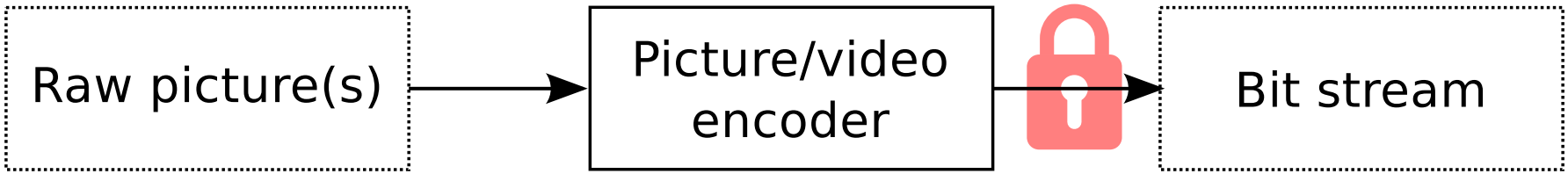
Overview

- Use case: Video surveillance
  - Surveillance camera captures images
  - Camera encodes images (SVC)
  - Faces (regions of interest) have to be encrypted before storage
- Scenario: Regions of interest are placed in slice groups
- Questions
  - Does it make encryption easier?
  - What restrictions does it entail?
  - How much more bandwidth does it require?



Post-compression encryption





- Encryption after encoding/compression (at bit stream level)

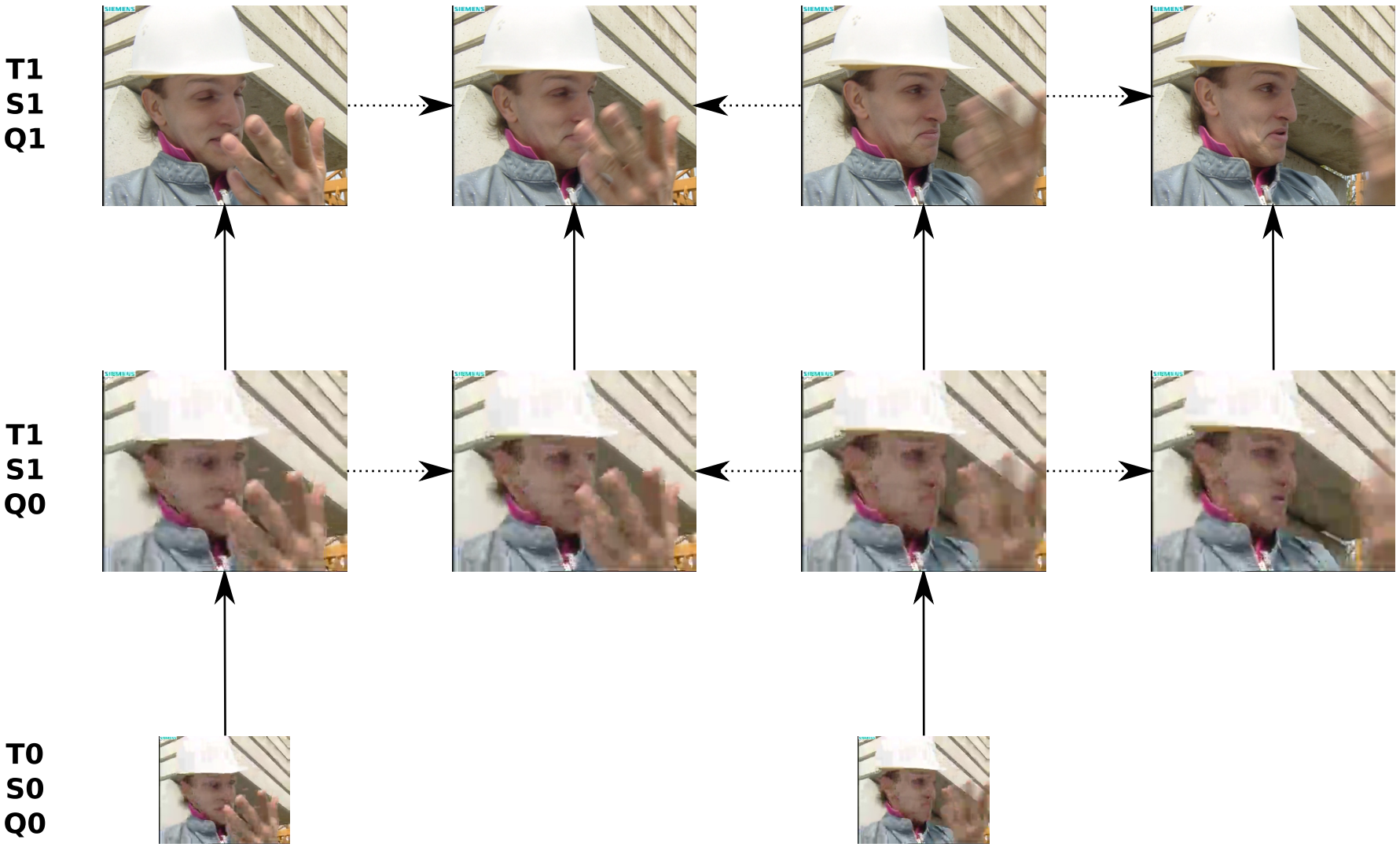
→ Re-encoding not necessarily required → typically fast

- Problem of **drift**

Drift

- Example: IP* GOP structure, eyes in first frame are encrypted
- Spatial vs. temporal drift (depicted: frames 1, 2 and 10)

SVC (Scalable Video Coding)



Slice groups

- Independent groups of macroblocks → contain spatial drift
- Focus: Rectangular slice groups with background (mode 2)

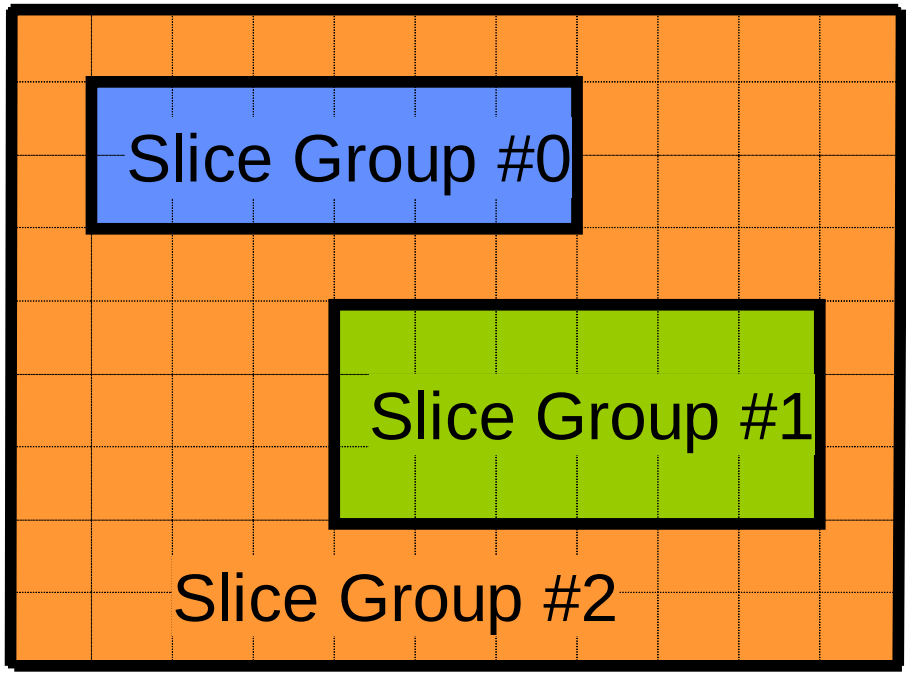
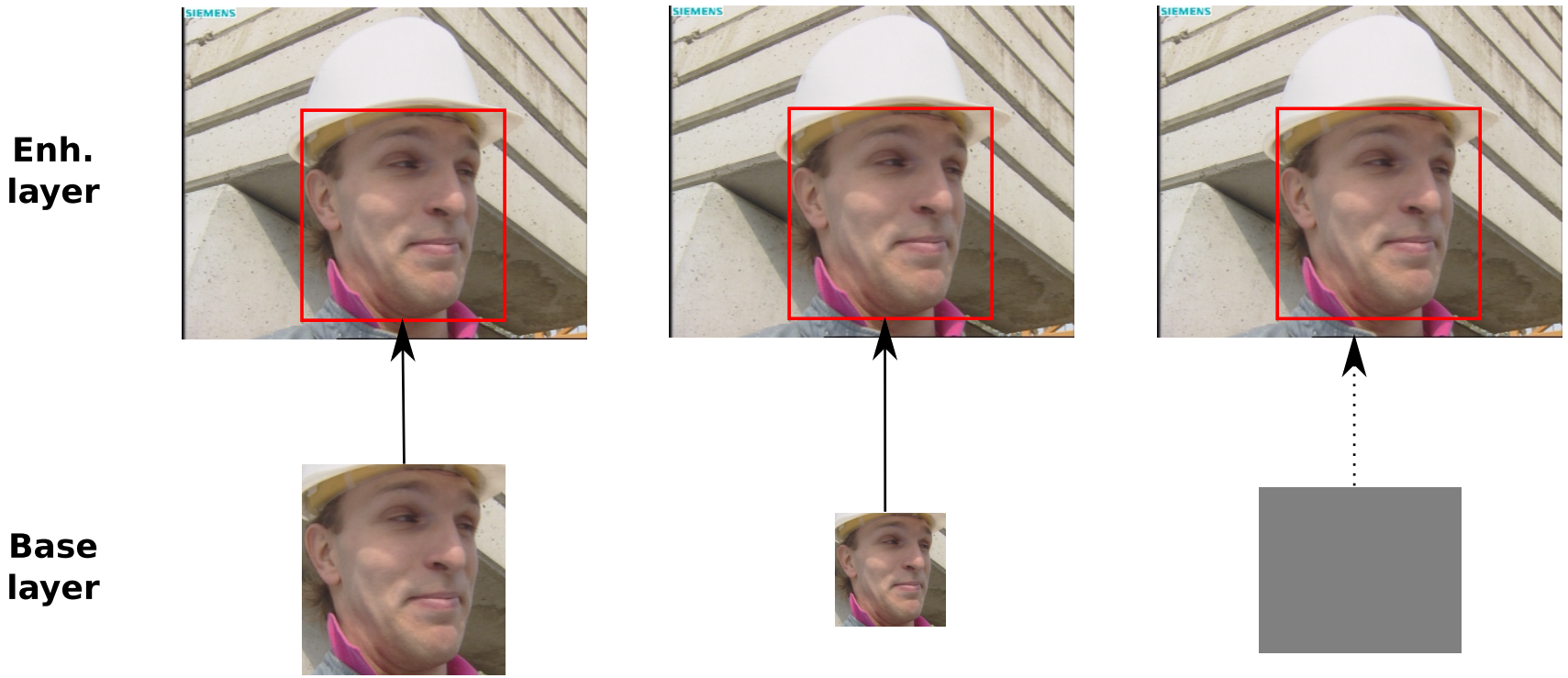


Image source: Wiegand, T. and Sullivan, G. J.: The H.264 | MPEG-4 AVC Video Coding Standard. http://ip.hhi.de/imagecom_G1/assets/pdfs/H264_03.pdf (8.4.2014), 2004.

SVC limitations

- Slice groups only supported in Scalable Baseline profile
- Detailled list of limitations (e.g., no B frames) in paper
- No slice groups allowed in base layer $\rightarrow$ possible workarounds
- Proposed workaround: All-grey base layer

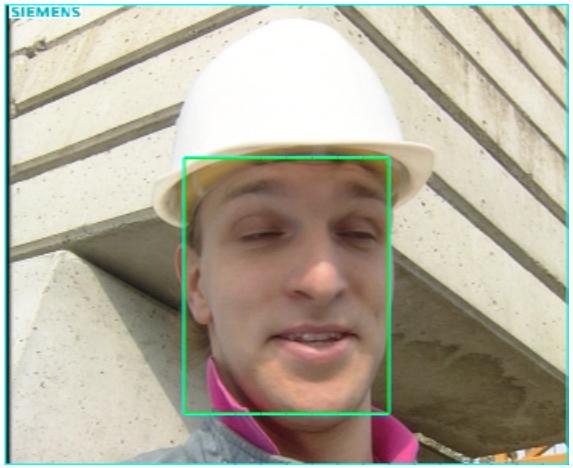


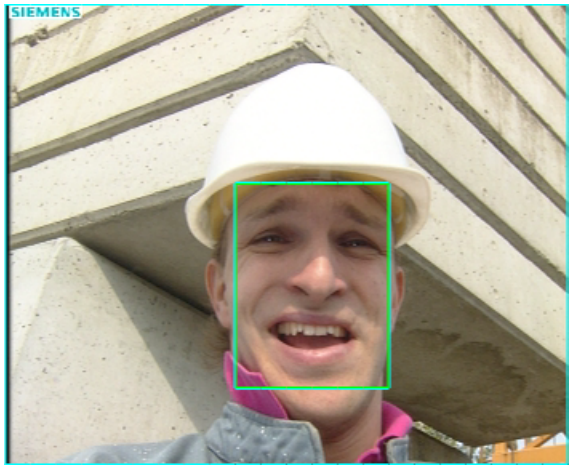
Implementation

- Moving slice groups (depicted: frames 1, 11 and 21)

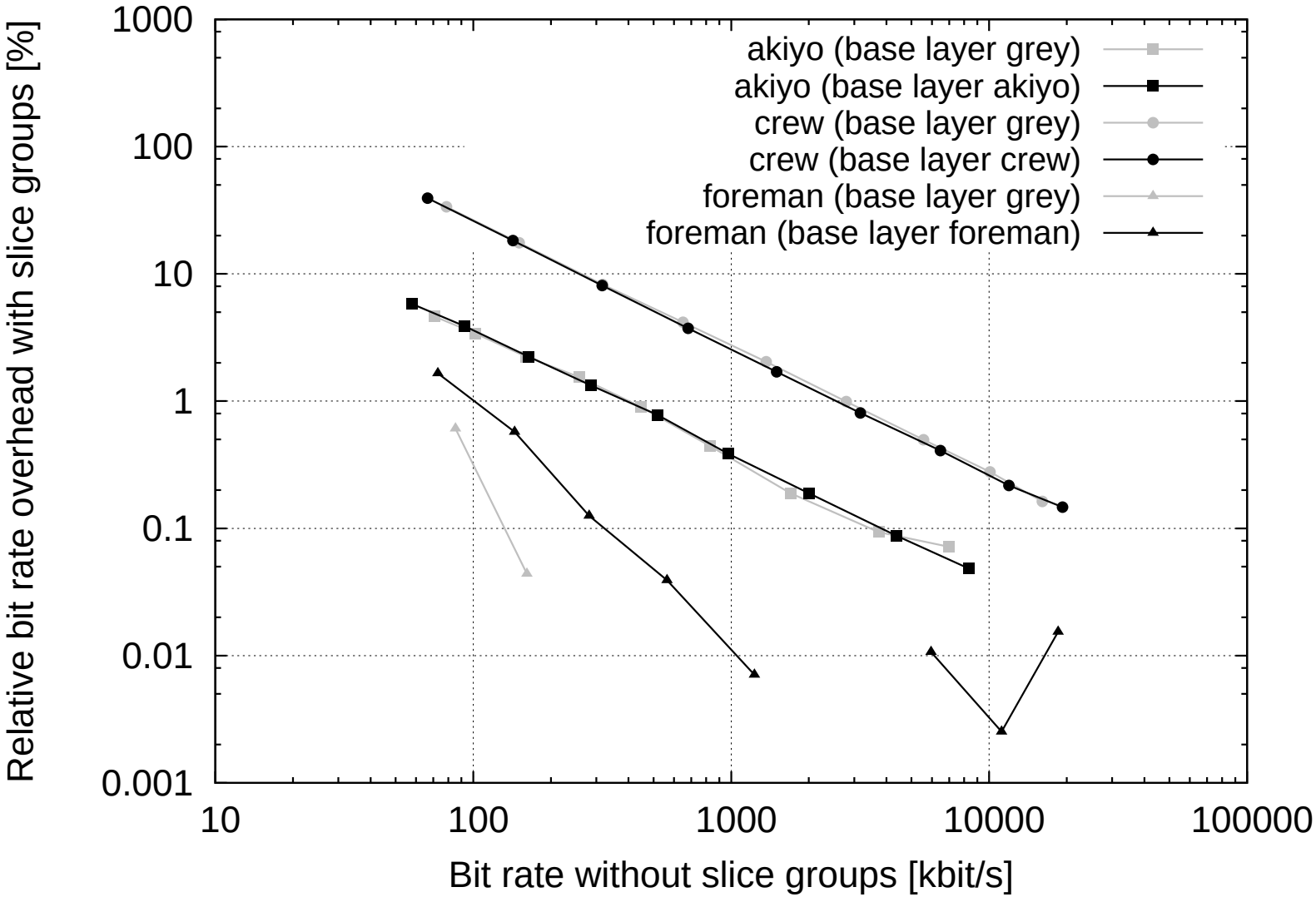
→ Slice group count and positions change per frame

- Modification of SVC reference software (JSVM)
- Manual face detection to determine slice group positions
- Setup: Dyadic spatial layers, I(PPP)* GOP structure

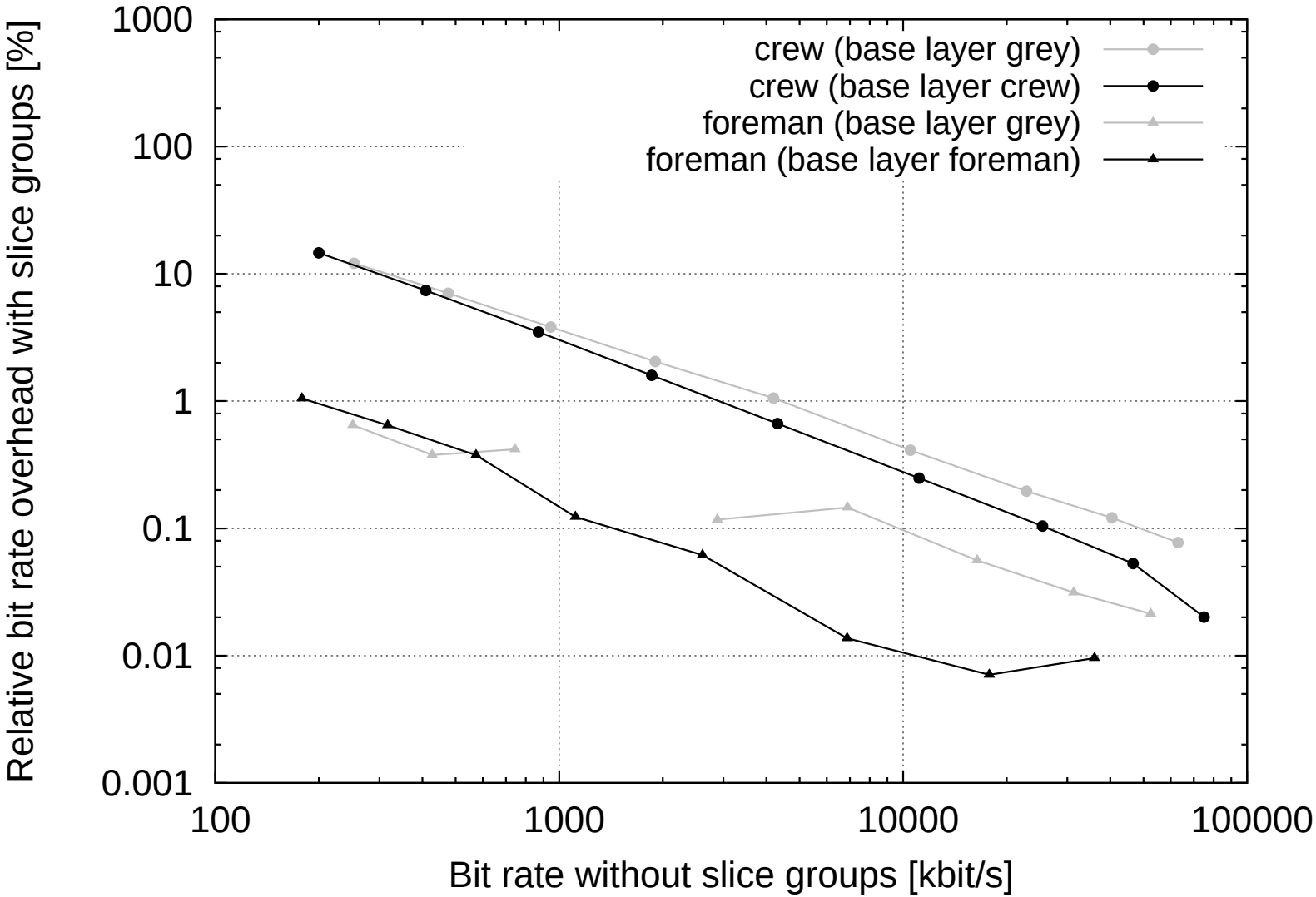




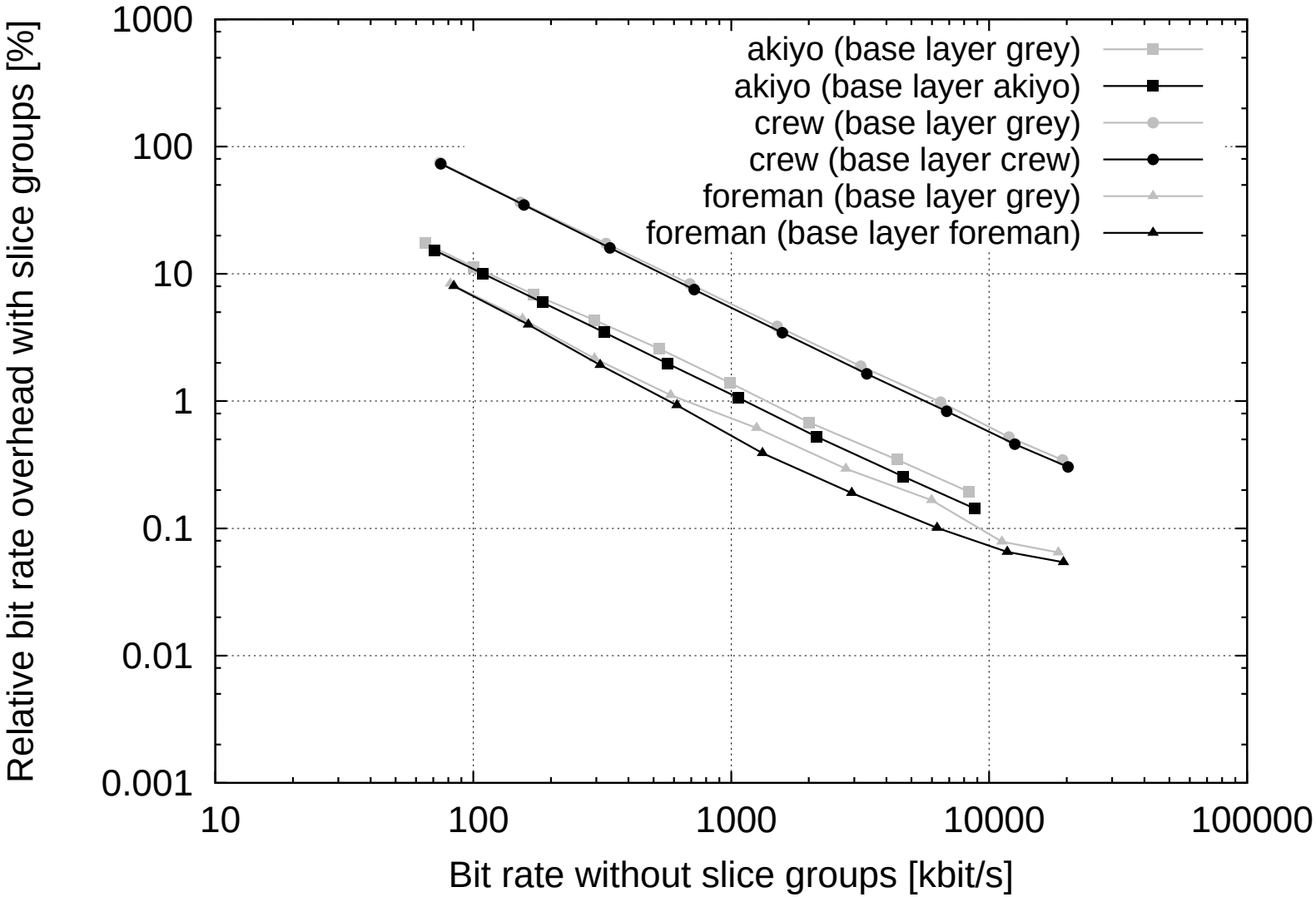
Overhead: Two spatial layers (CIF resolution)



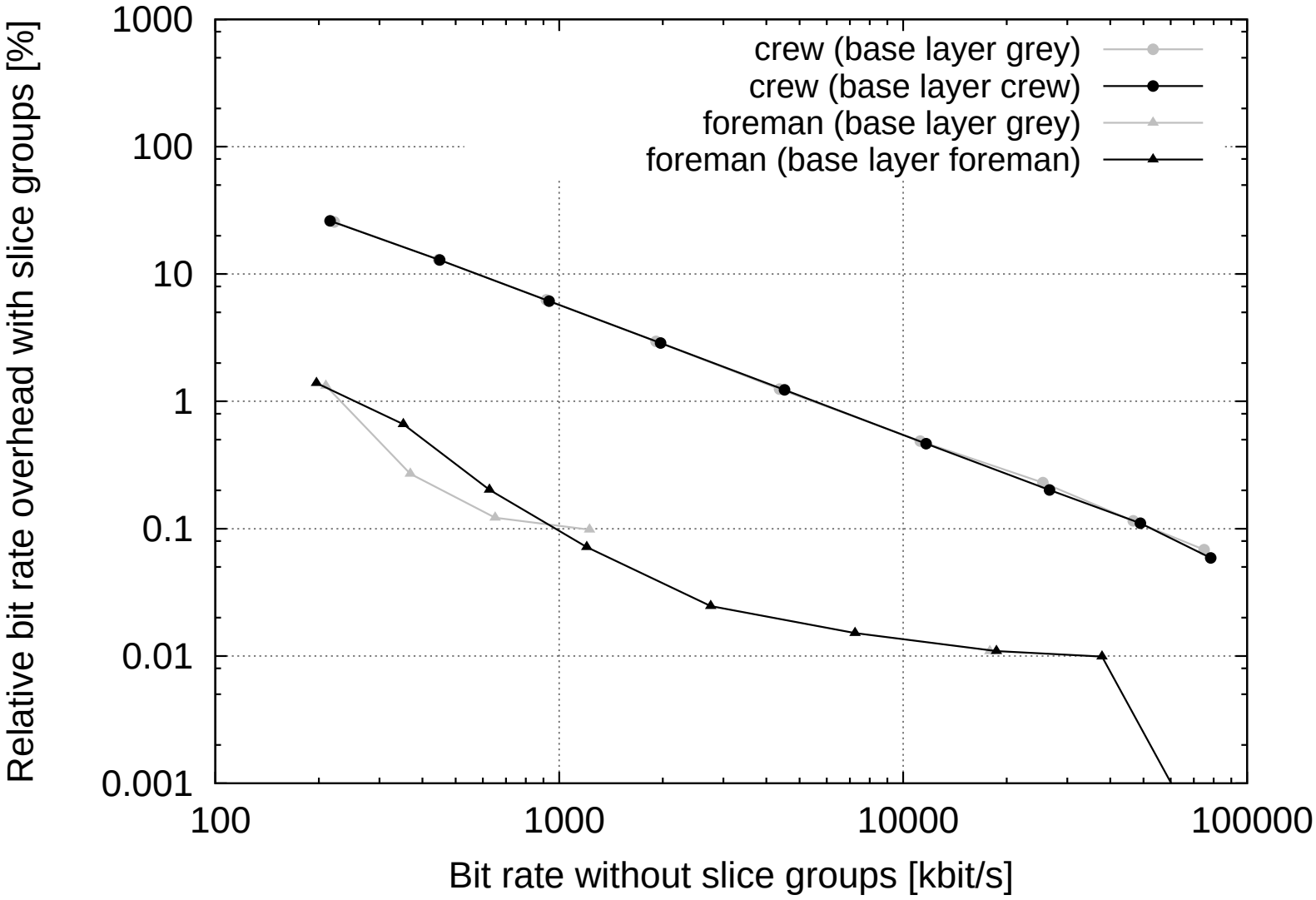
Overhead: Two spatial layers (4CIF resolution)



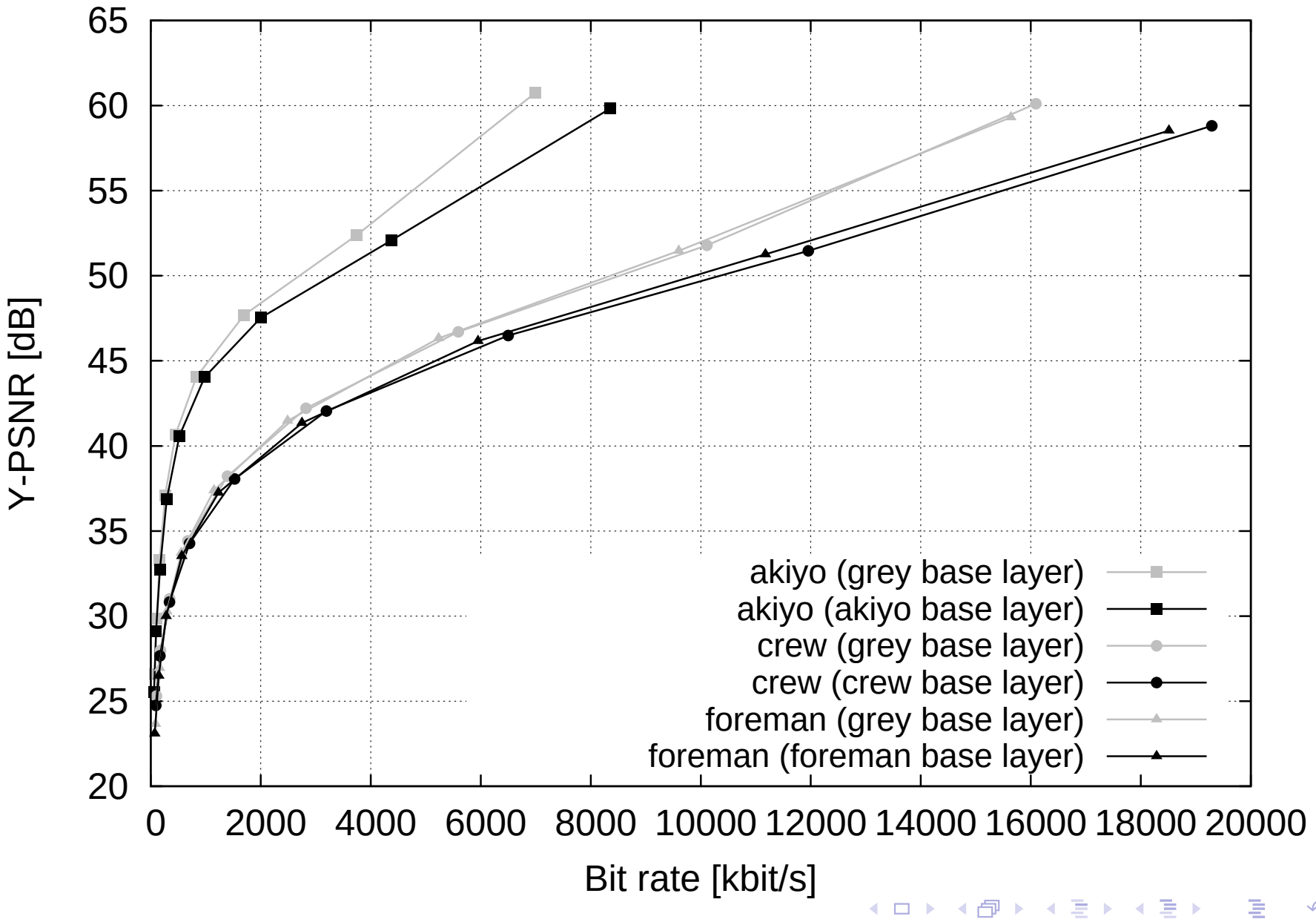
Overhead: Three spatial layers (CIF resolution)



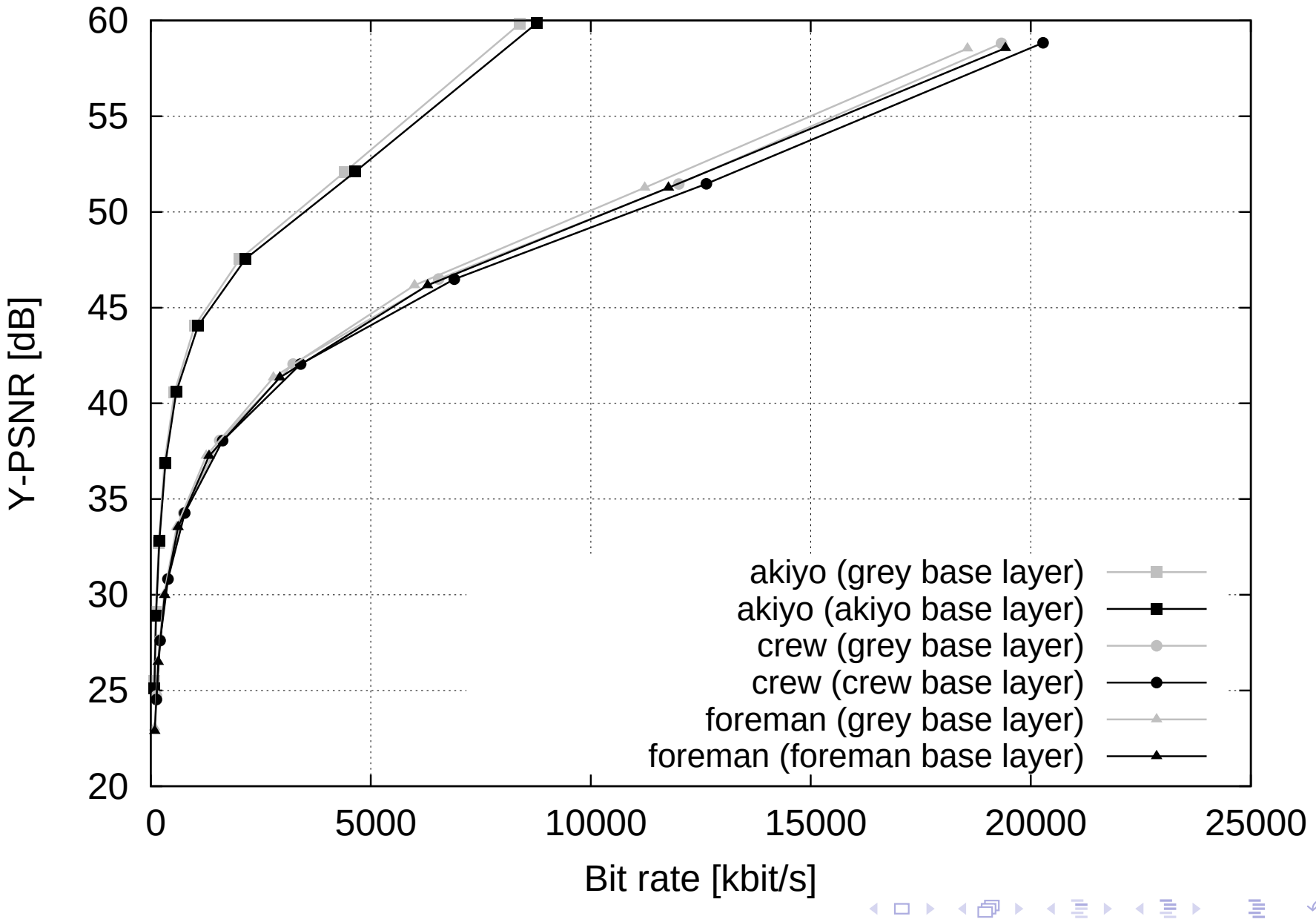
Overhead: Three spatial layers (4CIF resolution)



RD performance: Two spatial layers (CIF resolution)



RD performance: Three spatial layers (CIF resolution)



Conclusion

- Slice groups eliminate spatial drift (temporal drift is still an issue!)

→ Simplifies encryption (at the cost of one grey spatial layer)

- Low overhead at medium and high bit rates
- High overhead at low bit rates at CIF resolution
- Moderate overhead at low bit rates at 4CIF resolution

→ Overhead decreases with increasing resolution

Thank you for your attention!

Questions?