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

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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)
Slice Groups for RoI Encryption in SVC

T1 S1 Q1

T1 S1 Q0

T0 S0 Q0
Slice groups

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

SVC limitations

- Slice groups only supported in Scalable Baseline profile
- Detailed list of limitations (e.g., no B frames) in paper
- No slice groups allowed in base layer → 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)

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Overhead: Two spatial layers (4CIF resolution)

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Overhead: Three spatial layers (CIF resolution)

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Overhead: Three spatial layers (4CIF resolution)
RD performance: Two spatial layers (CIF resolution)
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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
Questions?