Cloud-based Workflow for AVC Film Grain Synthesis

09-MAY-2023

MHV 2023

Presenter:
Vijayakumar Gayathri Ramakrishna – ITTIAM

Co Authors:
Kaustubh Shripad Patankar – ITTIAM
Mukund Srinivasan - ITTIAM

Outline

- Introduction to Film Grain Technology
- Cloud Workflow for Grain Parameter Insertion
- Tools for Grain Parameters Processing
- Grain Parameters Estimation Process
- Results and Conclusion

Keywords and Acronyms

Acronym	Description
FGC SEI	Film Grain Characteristics Supplemental Enhancement Information
FGS	Film Grain Synthesis Process
FGS Rewriter	Bitstream Editor to insert/alter FGS SEI
VOD	Video on Demand
OTT	Over the Top - Technology that delivers streamed content over the internet
AV1	AOM Video coding standard
AVC/H.264	ITU-T H.264 | ISO/IEC 14496-10 video coding standard
HEVC/H.265	ITU-T H.265 | ISO/IEC 23008-2 video coding standard
VVC/H.266	ITU-T H.266 | ISO/IEC 23090-3 video coding standard
WASM	WebAssembly
JS	JavaScript

Introduction to Film Grain Technology

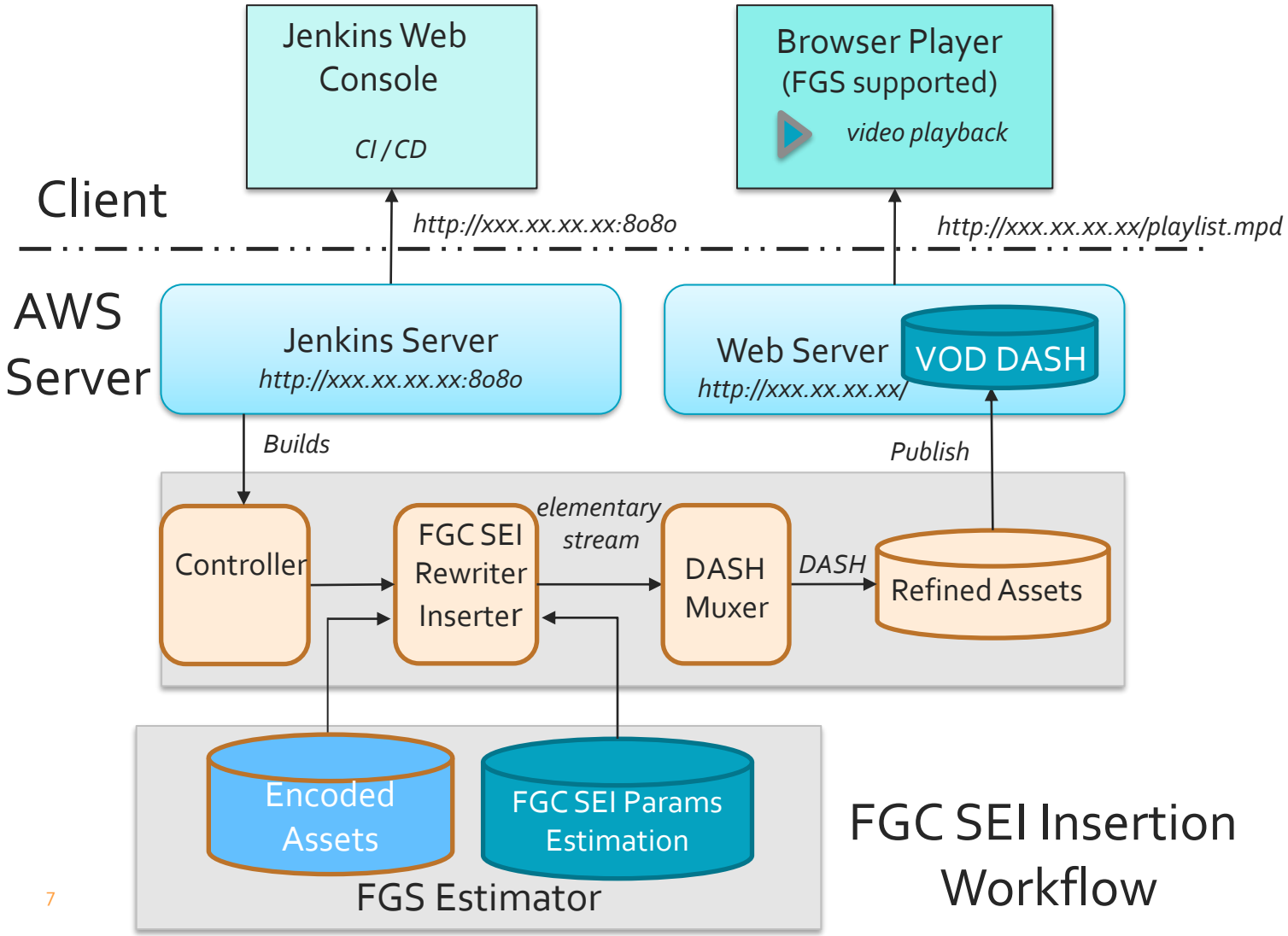
Film Grain Technology

Technology in Codecs	Part of multiple video coding standards	AVC, HEVC, VVC AV1
	AV1	Mandatory synthesis process Auto Regressive Model
	AVC, HEVC, and VVC	Optional synthesis process Frequency Filtering and Auto Regressive
Classic Application	Video preprocessing	Denoising of input Improves compression efficiency
	Removed Noise	Modelled as FGC SEI parameters Signalled as metadata
	Video Post Processing	Re-synthesize the noise Re-create original look of the video
Artifact Mitigation Application	Video Editing	Video sources do not have noise Add artificial "Comfort Noise"
	Compression Aid	Masking coding artifacts Improve sharpness at low bitrates
	Content Adaptive	Grains are content dependent Analysis at scene / segment level

Cloud Workflow for Grain Parameter Insertion

Cloud Workflow Diagram

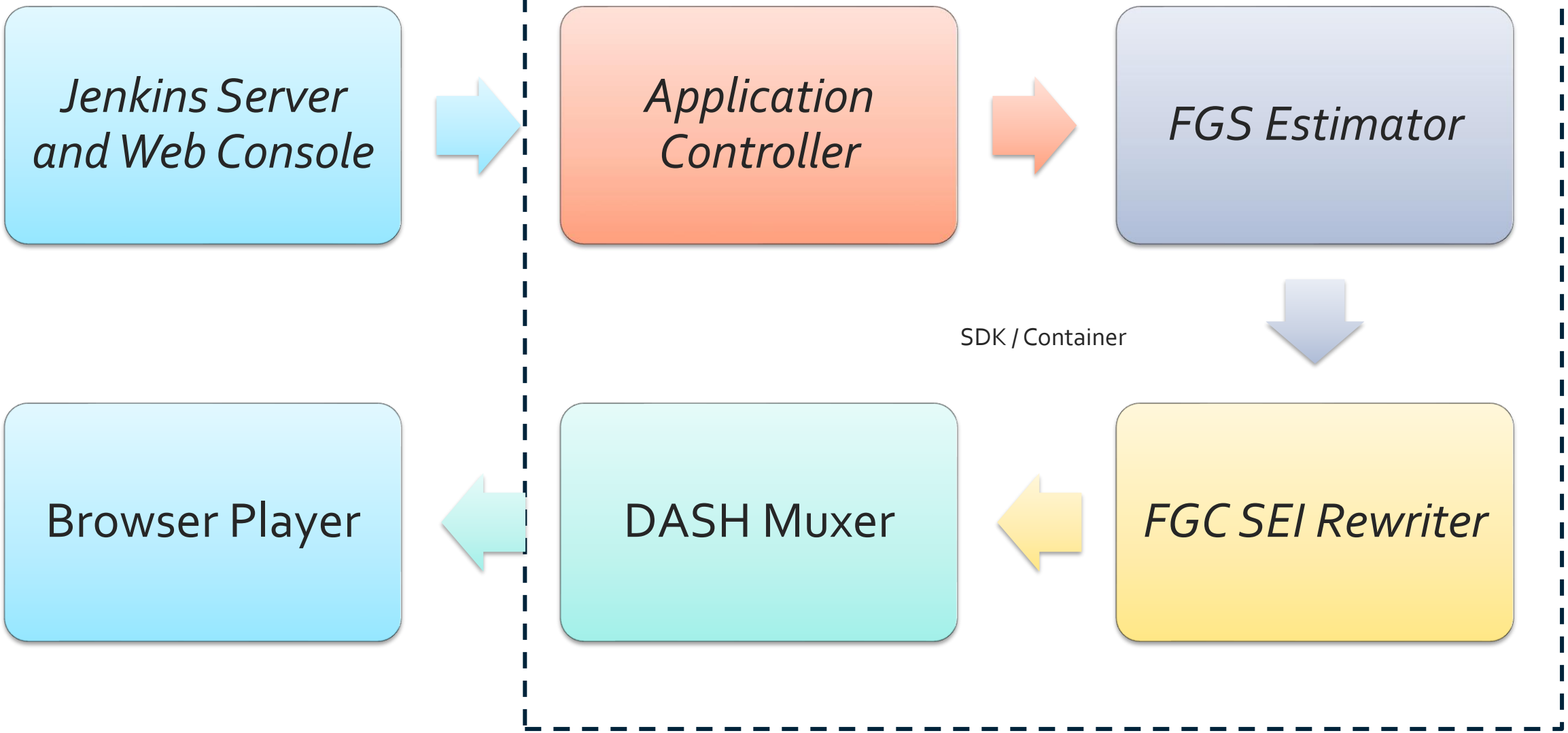
SERVER CLIENT MODEL



FGC SEI Insertion Workflow

- Content without Film grains
- Low bitrate applications
- Designed as Server – Client model
- Browser-based playback using WASM
- Streaming and OTT applications
- Avoids transcoding and hence preserving quality

Components of Workflow



Tools for Grain Parameters Processing

Key Tools for FGC / FGS

FGS Synthesis FGS Synthesis software in GitHub

- https://github.com/ittiam-systems/libfgs

FGC SEI Rewriter FGC SEI Rewriter software in GitHub

- https://github.com/ittiam-systems/libfgc-rewriter

H264 Decoder Decoder supporting FGC SEI Parsing and export

- https://github.com/ittiam-systems/lib264

WASM Player Brower based demo player

- https://demo.ittiam.com/demo/i264_fgs

Film Grain Rewriter / Inserter

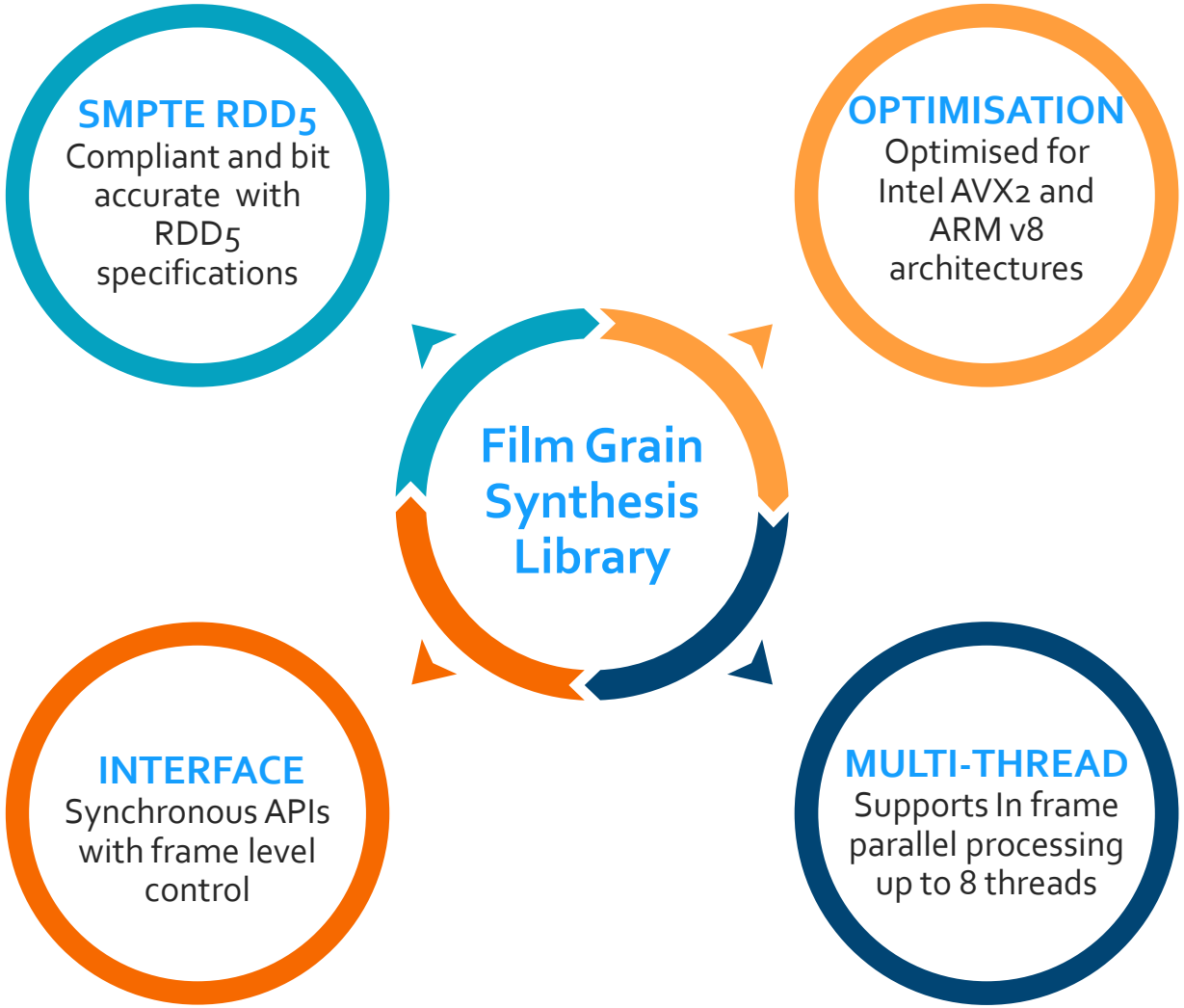
Low complexity utility used for editing and inserting FGC SEI messages

Supports 2 modes of operation

- FGC SEI editing with specific parameters modification
- SEI Insertion if there are no FGC SEI present in the stream

Currently supports AVC, can be extended to other MPEG standards

Film Grain Synthesizer Library

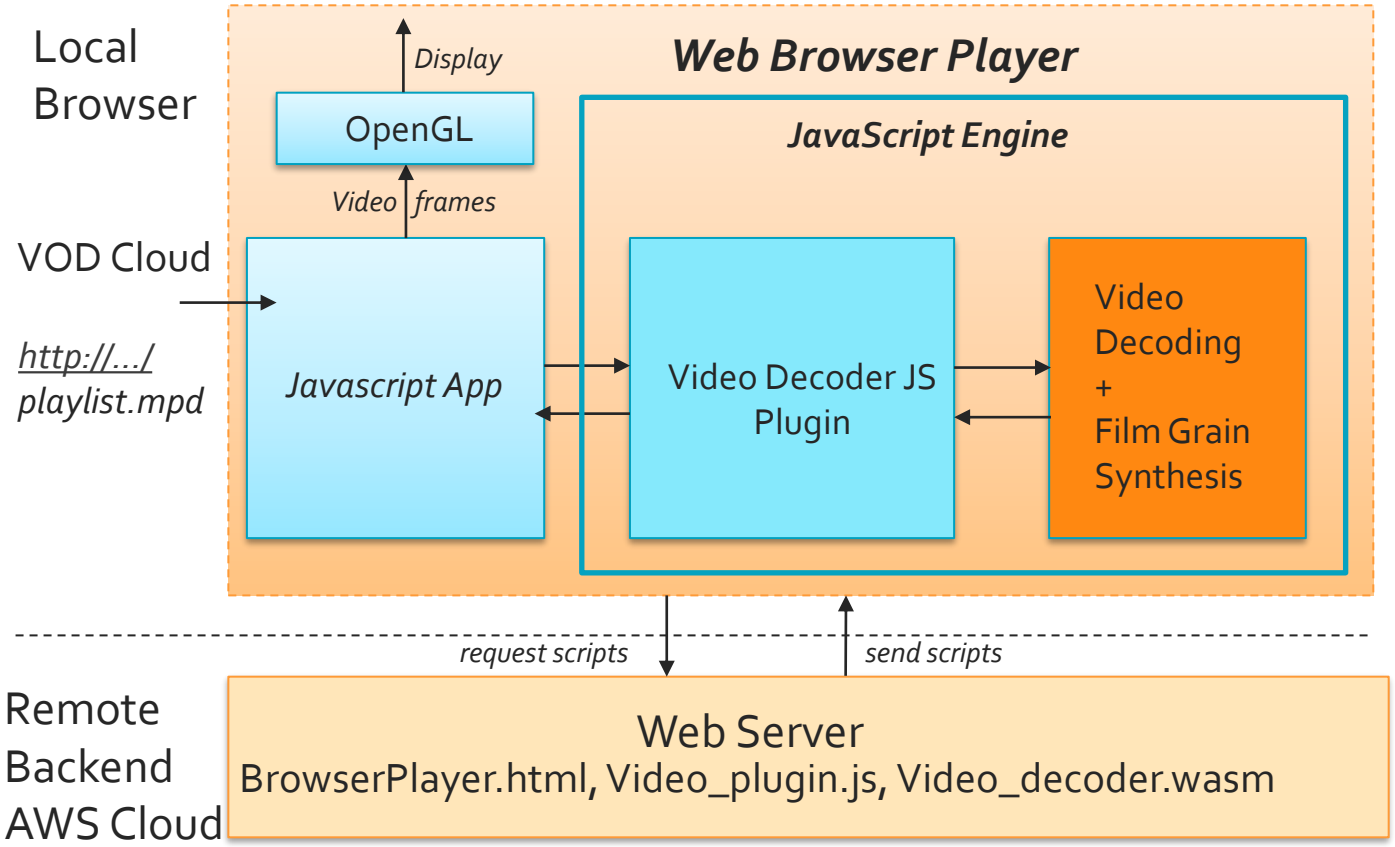


Film Grain Synthesis Performance on Single core

Processor	Frequency	1920x1080 processing time
i7-6770HQ	3.5 GHz	1.25 millisecond / frame [800 FPS]
Kryo 475	2.4 GHz	1.95 millisecond / frame [512 FPS]

Film Grain Video Player on Browser

- Media types supported
  - Local Media Playback
  - Cloud-hosted DASH Playback
- Operating system supported
  - Windows
  - Linux
  - Android
  - MacOS
- Web Browser supported
  - Microsoft Edge
  - Google Chrome
  - Mozilla Firefox
  - Safari



Grain Parameters Estimation Process

FGC Estimator

Objective

- Determine if the content/ scene can benefit from FGS SEI Insertion
- Determine the extent of blockiness, banding, loss of details and ringing artifacts
- Estimate the grain model parameters that can mask visual artifacts

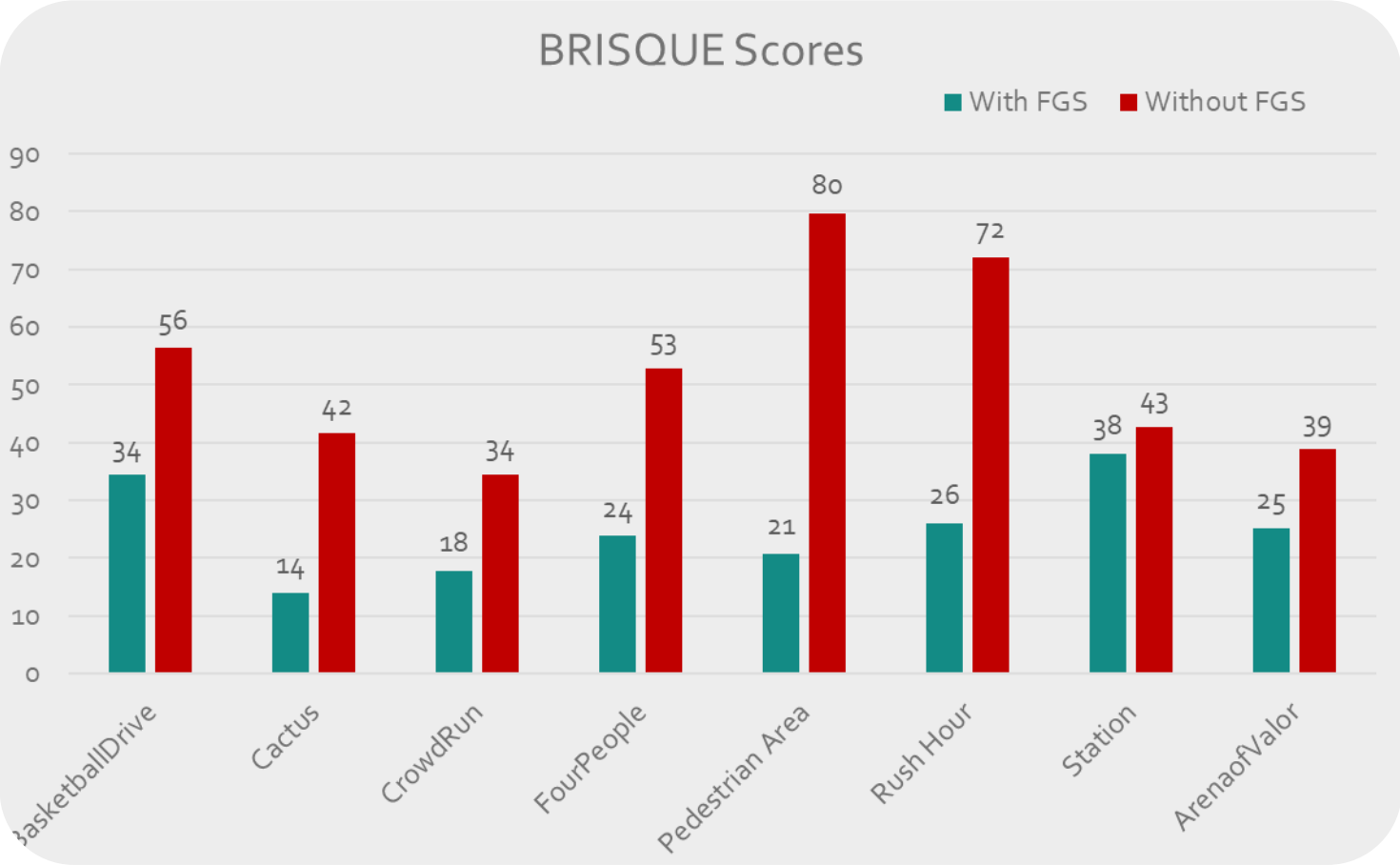
Approach

- Human eye is more sensitive to distortions in spatially low variance areas
- Assess the amount of banding and blockiness in these low variance areas
- Determine intensity intervals and strength of noise which can aid in masking artifacts

Results and Conclusion

Results – Objective Assessment

BRISQUE – BLIND/REFERNECE LESS IMAGE SPATIAL QUALITY EVALUATOR

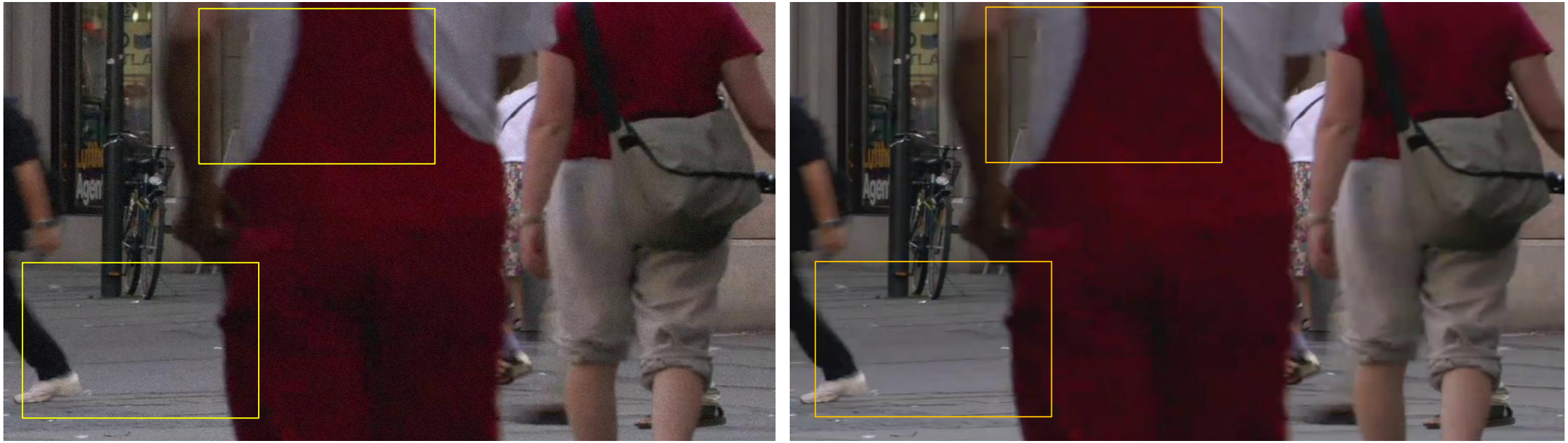


1080p contents encoded at bitrates ranging from 3Mbits/ sec to 6Mbits/sec using industry standard AVC Encoders

- Non-reference metric to evaluate image quality in the spatial domain
- Ranges from 0 to 100, wherein a lower score indicates a higher quality and vice versa
- BRISQUE scores are consistently lower with FGS as compared to without FGS

Results – Subjective Assessment

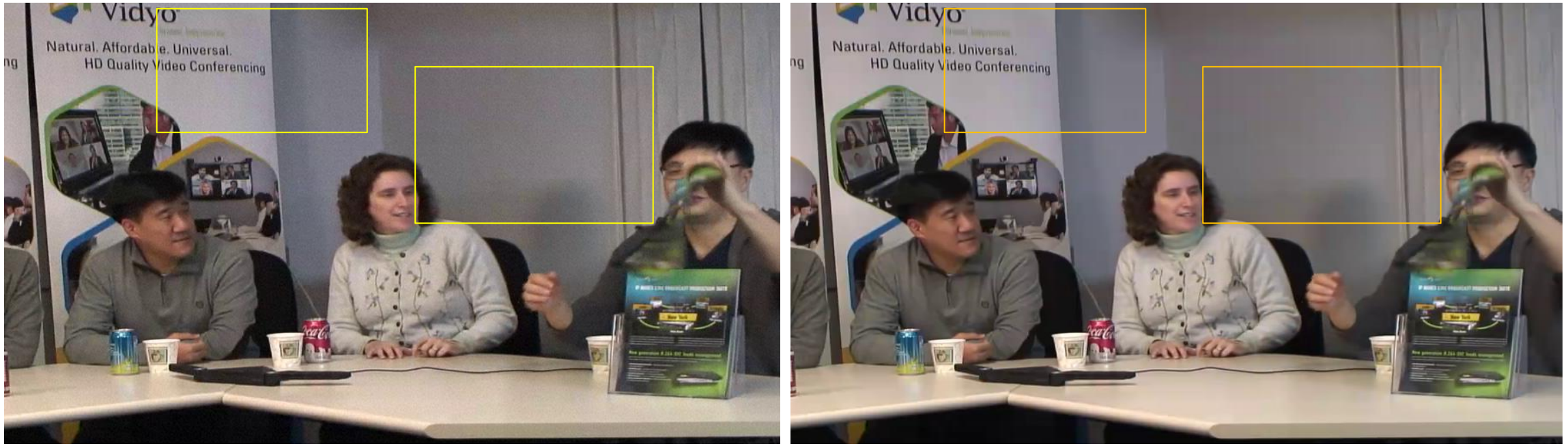
BASED ON ITU-R-BT.500 SPECIFICATIONS



Snapshot 1: Pedestrian Sequence Left (With FGS) Right (No FGS)

Results – Subjective Assessment

BASED ON ITU-R-BT.500 SPECIFICATIONS



Snapshot 2: Four People Sequence Left (With FGS) Right (No FGS)

Conclusion

FGS helps in masking artifacts, and sharper pictures and preserves text [Improves Perceived Quality]

BRQISUE Scores and Subjective Quality tests show the advantages of FGS

Streaming service providers can enable FGC SEI in encoded assets without re-encoding

FGS can also aid in bitrate savings with minimal effect on perceived quality

FGS synthesis process is Lightweight and Adaptable across MPEG standards

Consistent synthesis process across devices because of bit-accurate implementation

THANK YOU

Contact Info
Website : https://www.ittiam.com/
Email : info@ittiam.com