Beyond One-Size-Fits-All



Dr. Hadi Amirpour

ITEC, University of Klagenfurt, Austria

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WP1

Hadi Amirpour · Ekrem Çetinkaya · Vignesh V Menon · Mohammad Ghasempour · Yiying Wei · Kamran Qureshi

+120
papers co-authored

+27
journal articles

+13
US patents, more pending

3
PhDs (Amirpour, Çetinkaya, Menon)

Awards and recognition

- **Best Student Paper**, NAB BEIT 2025 (Ghasempour)
- **Best Paper Award**, PCS 2024 (Amirpour)
- **Best Doctoral Paper**, ACM MMSys 2021 (Çetinkaya)
- **Innovation Award**, Streaming Media 2021
- **Open source:** VCA, DeepVCA, VCD and SVD datasets
- **Tutorials** at IEEE ICME, IEEE VCIP and ACM MM

Sources: ATHENA publication list (≥1 WP author) · USPTO via Justia, Oct 2026 (≥1 WP inventor) · Google Scholar Metrics 2025

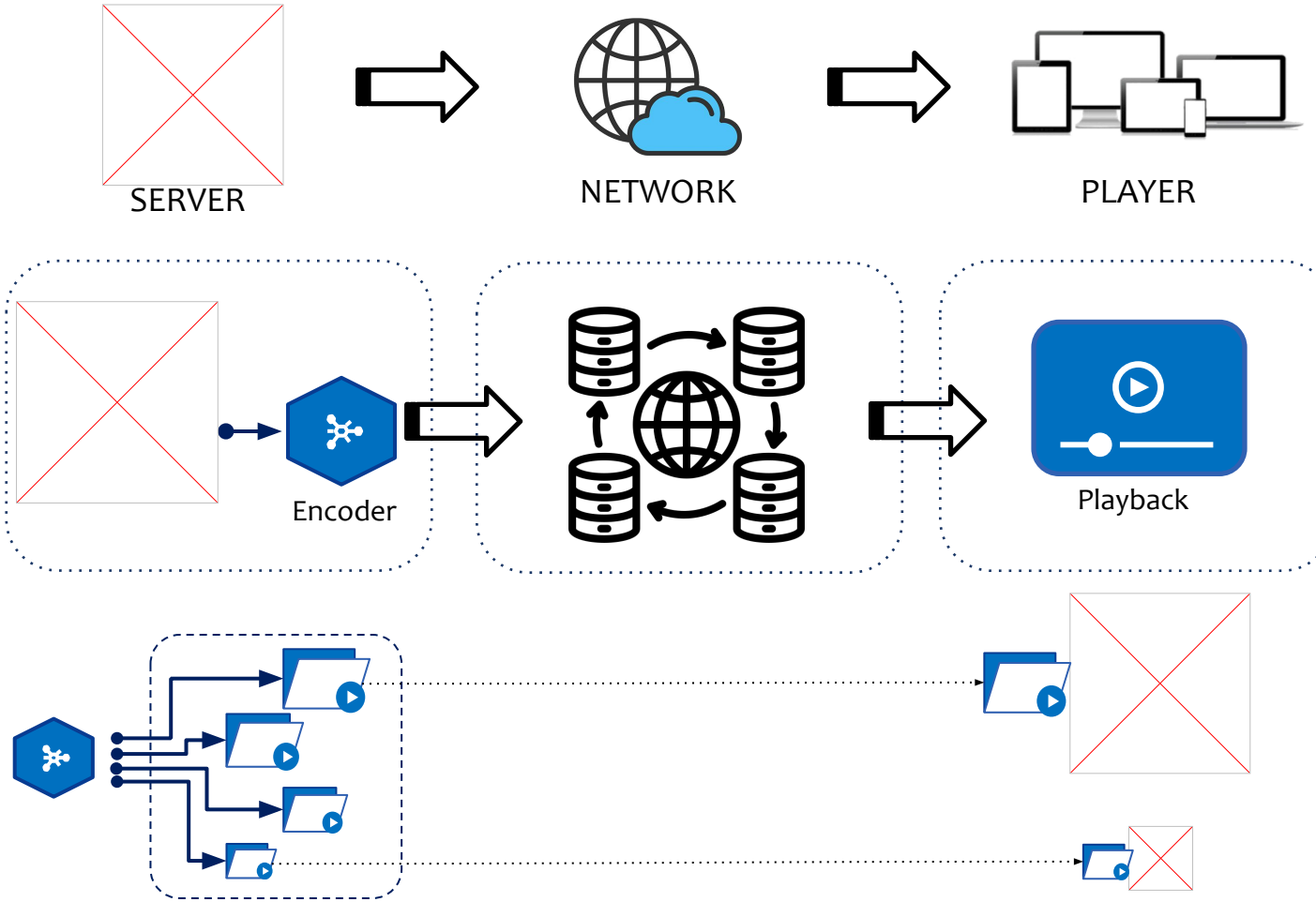
Our venues in Google Scholar's top-20 lists

Multimedia	Signal Processing	Networks & Wireless	Computing Systems
1. Multimedia Tools & Apps	**1. IEEE TIP**	1. IEEE TWC	**1. IEEE IoT Journal**
2. ACM Multimedia	2. IEEE TWC	**2. IEEE COMST**	2. FGCS
3. IEEE TCSVT	**3. IEEE ICASSP**	3. IEEE TVT	3. Internet of Things
4. IEEE TMM	4. INTERSPEECH	4. IEEE JSAC	4. J. Supercomputing
5. ACM TOMM	**5. IEEE TCSVT**	5. IEEE TCOM	5. IEEE TPDS
6. IEEE ICIP	6. IEEE WCL	6. JNCA	6. Cluster Computing
7. IET Image Processing	7. IEEE TSP	7. Computer Comm.	7. ASPLOS
8. SP: Image Communication	8. IEEE/ACM TASLP	8. IEEE WCL	8. USENIX NSDI
9. Multimedia Systems	9. IEEE JSTSP	9. IEEE TMC	9. USENIX OSDI
10. IEEE ICME	10. IEEE SPL	10. Computer Networks	10. IEEE TSC
11. JVCIR	11. IEEE SP Magazine	11. IEEE Wireless Comm.	11. ISCA
12. ISMIR	**12. Signal Processing**	12. IEEE Network	12. JPDC
13. Comp. Visual Media	**13. IEEE ICIP**	13. IEEE Comm. Magazine	13. Concurrency & Comp.
14. ACM ICMR	14. IET Image Processing	14. IEEE Comm. Letters	14. J. Systems Architecture
15. Int. J. Multimedia IR	**15. SP: Image Comm.**	15. IEEE Systems Journal	15. MLSys
16. ACM MMSys	16. IEEE TCI	16. IEEE INFOCOM	16. IEEE HPCA
17. IEEE MultiMedia	**17. IEEE ICME**	17. Wireless Pers. Comm.	17. IEEE/ACM MICRO
18. Multimedia Modeling	18. Digital Signal Proc.	18. IEEE ICC	18. USENIX ATC
19. IEEE MMSP	19. SIViP	**19. IEEE TNSM**	19. Scientific Programming
20. IEEE ICMEW	20. IEEE VTC	20. IEEE OJ-COMS	20. ACM EuroSys

Highlighted: the WP team has published there (ATHENA publication list) · Google Scholar Metrics, 2025 edition, h5-index 2020–2024

Introduction




SERVER
NETWORK
PLAYER
Encoder
Playback

Video Coding for Video Streaming

INPUTS

Source video
content, complexity, resolution, FPS

Target devices
CPU & GPU, screens, codecs

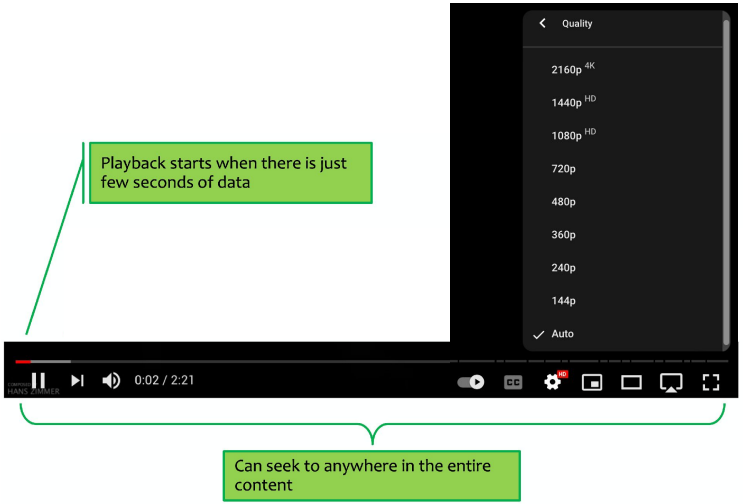
Network context
bandwidth, latency, packet loss

Service goals
QoE, startup time, rebuffering, cost, energy

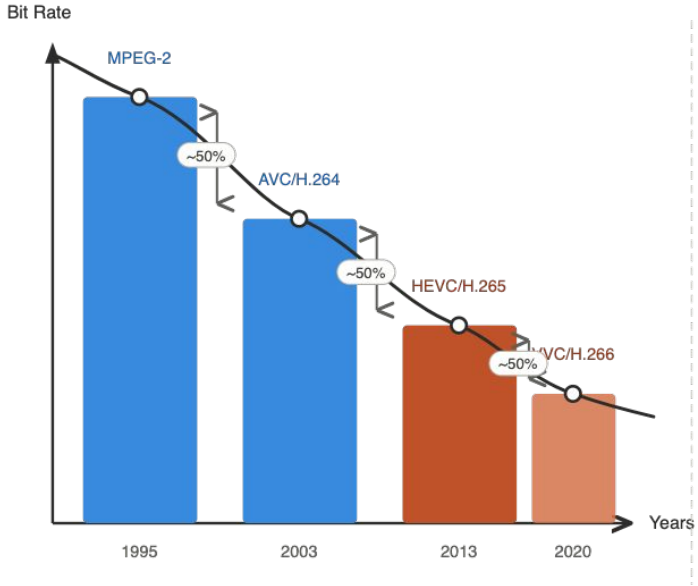


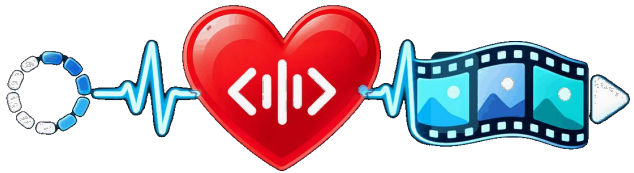
Ladder optimizer

decides **N** representations · resolution · bitrate

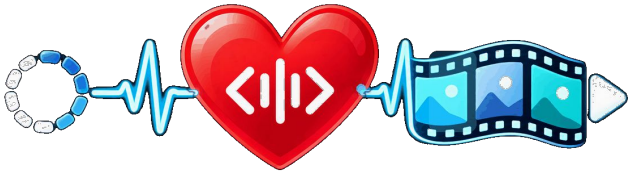


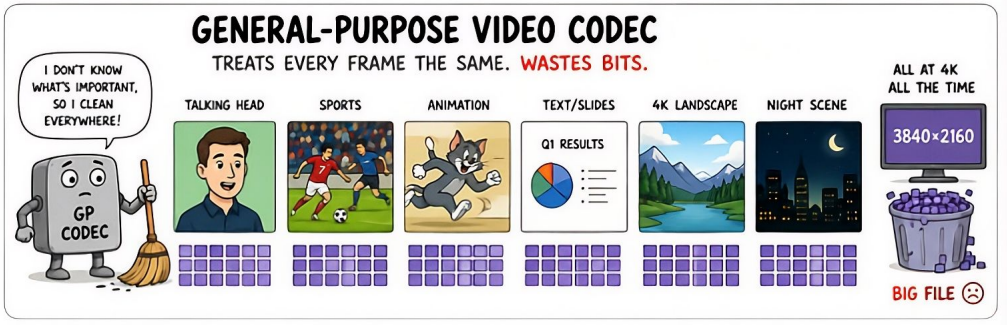
Video Coding Standards



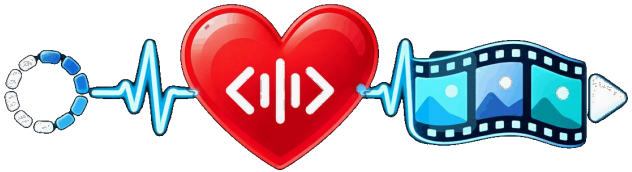


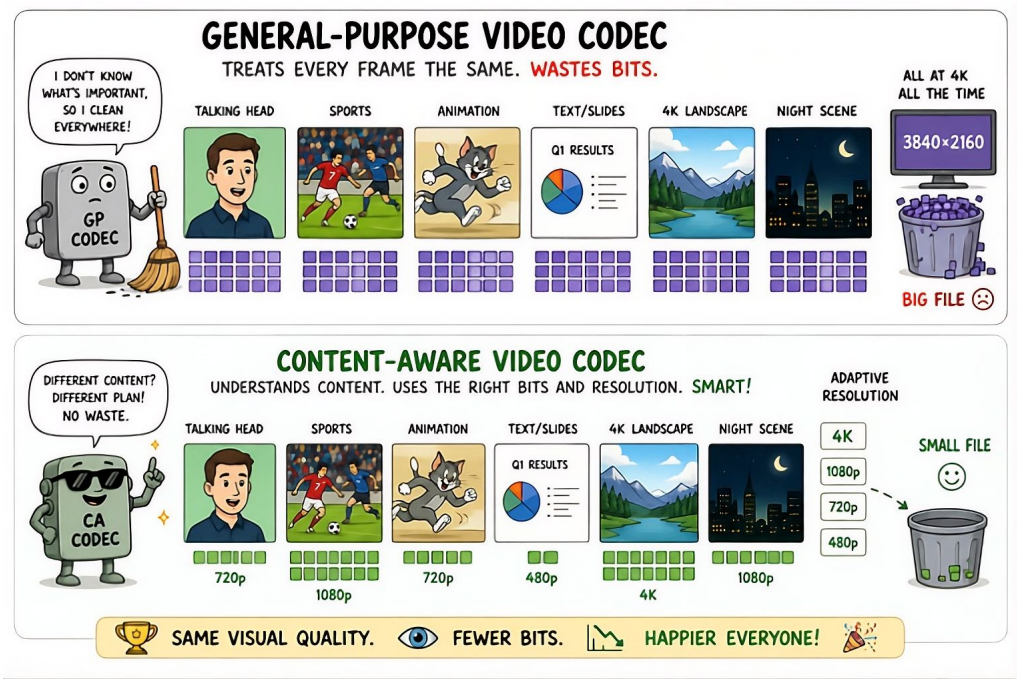
Content-aware Encoding



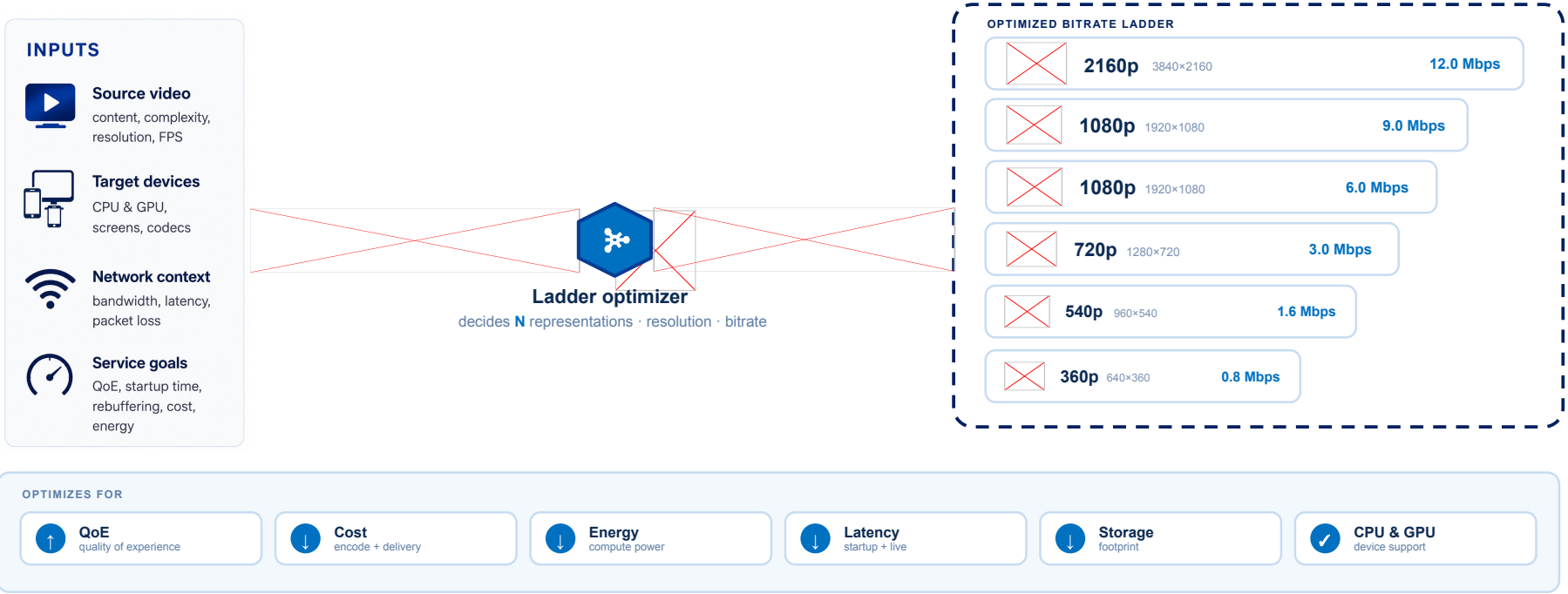


Content-aware Encoding

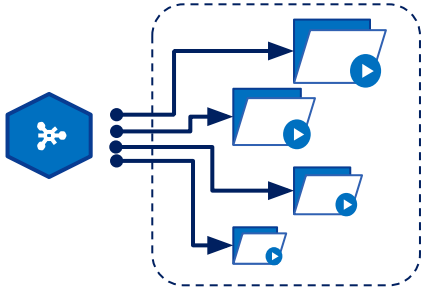




Video Coding for Video Streaming



Bitrate Ladder Construction

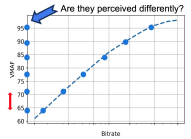




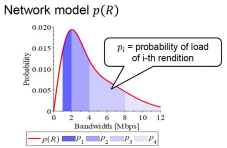
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Rep. #06	2400 kbps
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Rep. #10	8100 kbps
Rep. #11	11600 kbps
Rep. #12	16800 kbps

Bitrates

- Quality-aware



- Network-aware



Bitrate Ladder Construction



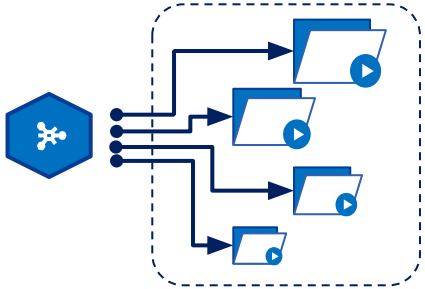
1.6Mbps
1080p



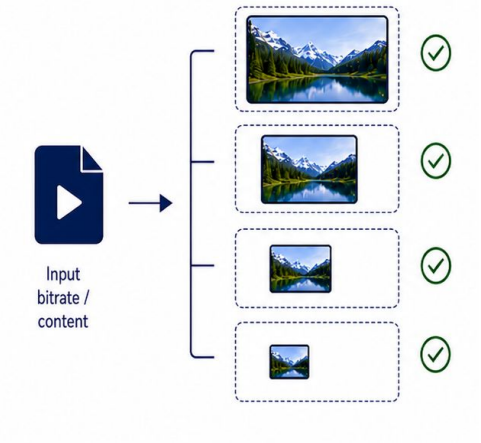
1.6Mbps
540p

V. V. Menon, H. Amirpour, M. Ghanbari and C. Timmerer, "OPTE: Online Per-Title Encoding for Live Video Streaming," IEEE ICASSP, 2022.

Bitrate Ladder Construction

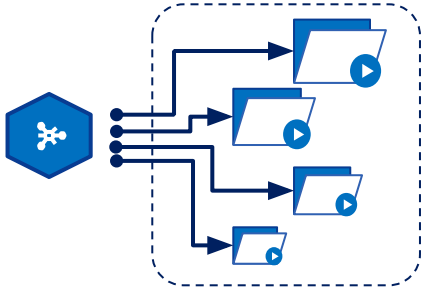


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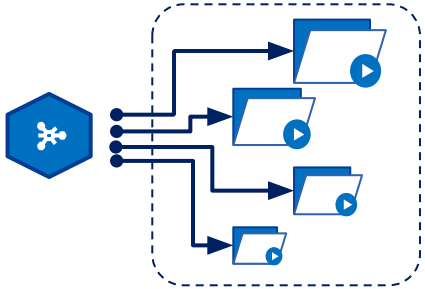
A. Telili, W. Hamidouche, H. Amirpour, et al, "Convex Hull Prediction Methods for Bitrate Ladder Construction: Design, Evaluation, and Comparison," ACM TOMM, 2025.

Bitrate Ladder Construction

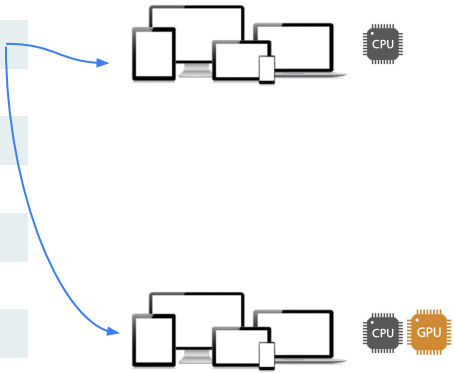


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Rep. #01	145 kbps	640x360	60	veryslow
Rep. #02	300 kbps	768x432	60	veryslow
Rep. #03	600 kbps	960x540	60	slower
Rep. #04	900 kbps	960x540	50	slow
Rep. #05	1600 kbps	960x540	50	medium
Rep. #06	2400 kbps	1280x720	50	medium
Rep. #07	3400 kbps	2180x720	30	fast
Rep. #08	4500 kbps	1920x1080	30	faster
Rep. #09	5800 kbps	1920x1080	30	veryfast
Rep. #10	8100 kbps	2560x1440	30	veryfast
Rep. #11	11600 kbps	3840x2160	24	superfast
Rep. #12	16800 kbps	3840x2160	24	ultrafast

Bitrate Ladder Construction

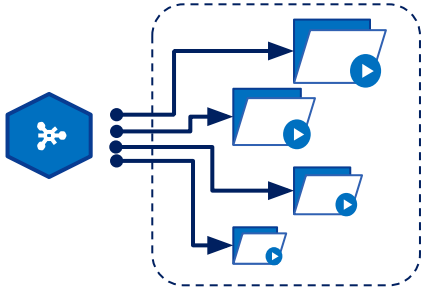


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Rep. #06	2400 kbps	1280x720	50	medium
Rep. #07	3400 kbps	2180x720	30	fast
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Bitrate Ladder Construction

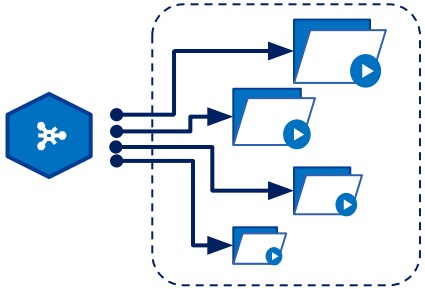
CPU vs GPU devices

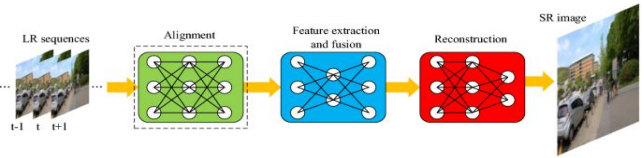


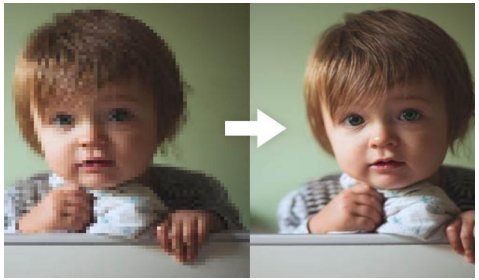


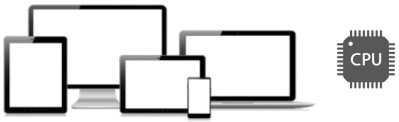
Bitrate Ladder Construction

CPU vs GPU devices







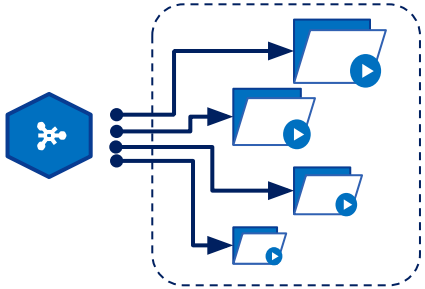




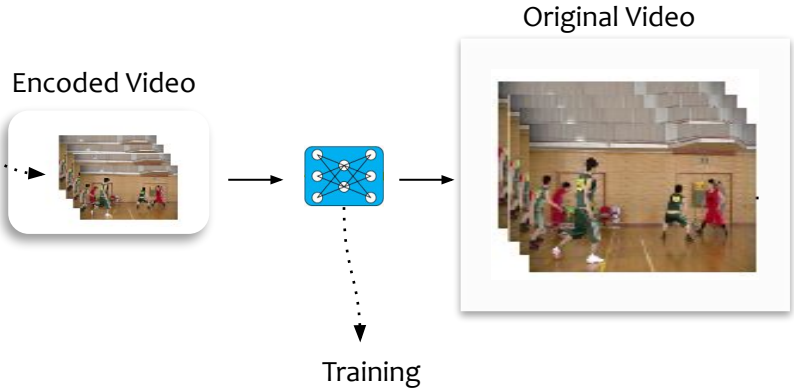
H. Amirpour, M. Ghanbari and C. Timmerer, "DeepStream: Video Streaming Enhancements Using Compressed Deep Neural Networks," IEEE TCSVT, 2025.

Bitrate Ladder Construction

CPU vs GPU devices (DNN training)



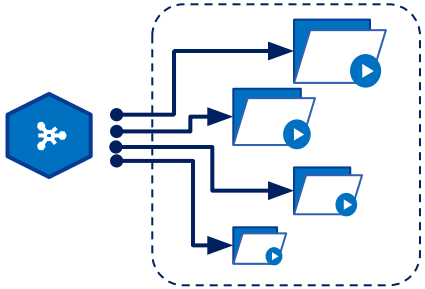
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Bitrate Ladder Construction

CPU vs GPU devices



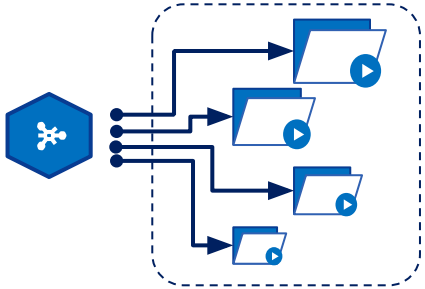
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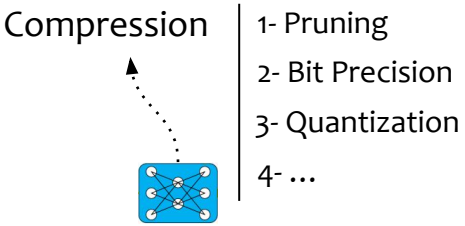
H. Amirpour, M. Ghanbari and C. Timmerer, "DeepStream: Video Streaming Enhancements Using Compressed Deep Neural Networks," IEEE TCSVT, 2025.

Bitrate Ladder Construction

CPU vs GPU devices (DNN Compression)



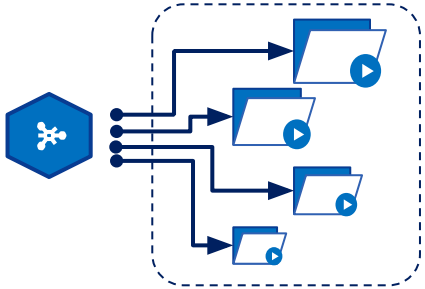
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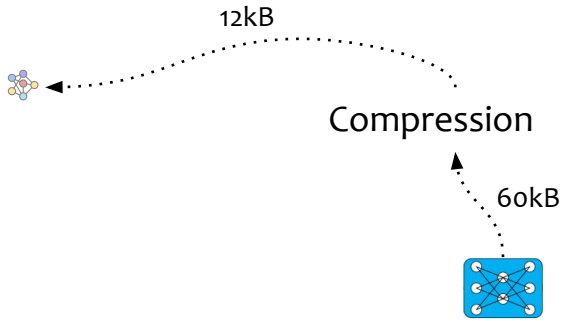
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Bitrate Ladder Construction

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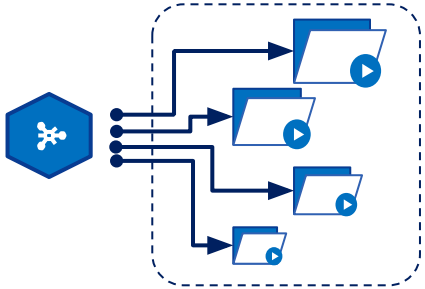
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Bitrate Ladder Construction

CPU vs GPU devices

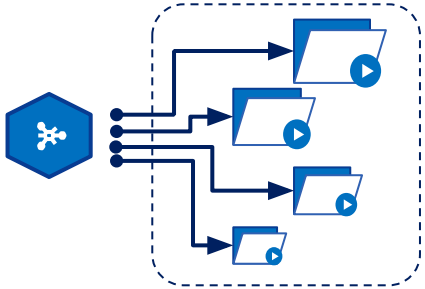


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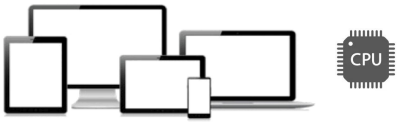
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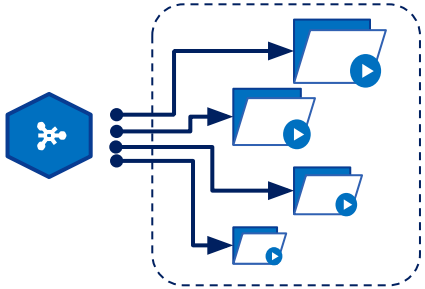




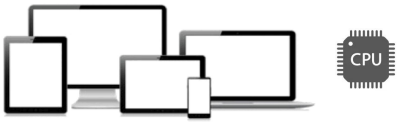
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Rep. #09	5800 kbps	1920x1080
Rep. #10	8100 kbps	2560x1440
Rep. #11	11600 kbps	3840x2160
Rep. #12	16800 kbps	3840x2160

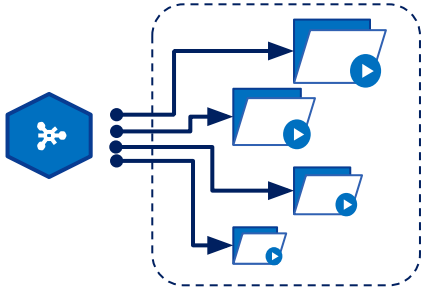




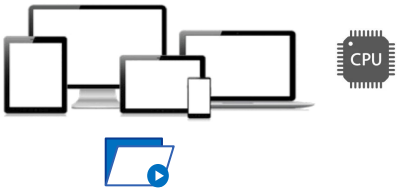
H. Amirpour, M. Ghanbari and C. Timmerer, "DeepStream: Video Streaming Enhancements Using Compressed Deep Neural Networks," IEEE TCSVT, 2025.

Bitrate Ladder Construction

CPU vs GPU devices



	Encoding Bitrate	Resolution
Rep. #01	145 kbps	640x360
Rep. #02	300 kbps	768x432
Rep. #03	600 kbps	960x540
Rep. #04	900 kbps	960x540
Rep. #05	1600 kbps	960x540
Rep. #06	2400 kbps	1280x720
Rep. #07	3400 kbps	1280x720
Rep. #08	4500 kbps	1920x1080
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Rep. #12	16800 kbps	3840x2160

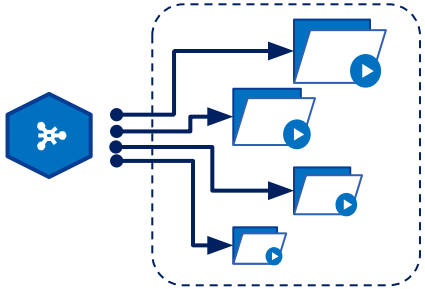




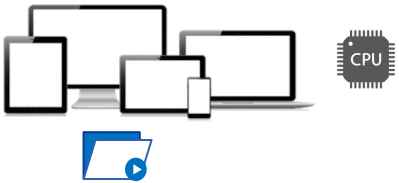
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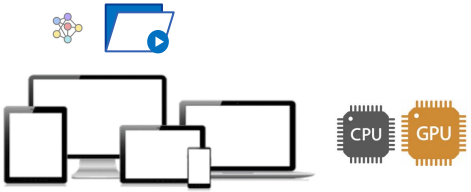
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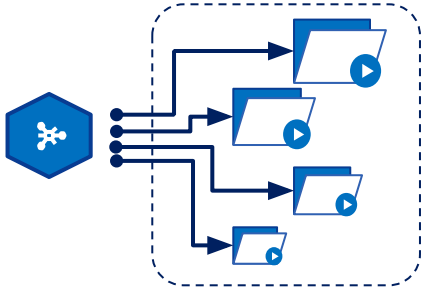


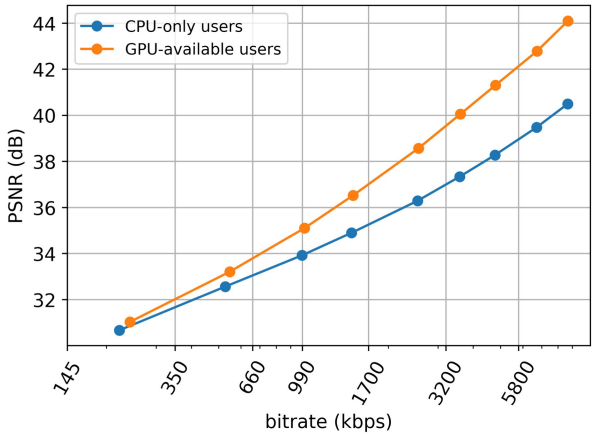


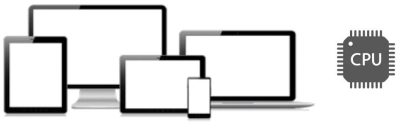
H. Amirpour, M. Ghanbari and C. Timmerer, "DeepStream: Video Streaming Enhancements Using Compressed Deep Neural Networks," IEEE TCSVT, 2025.

Bitrate Ladder Construction

CPU vs GPU devices (Compression Efficiency)





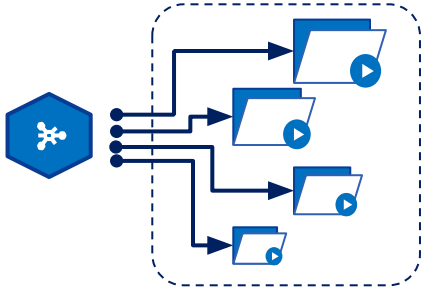


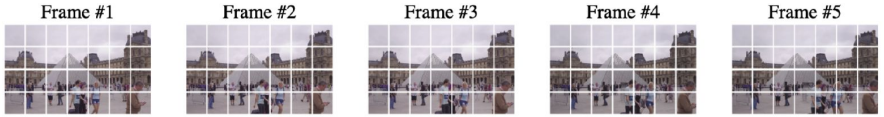


H. Amirpour, M. Ghanbari and C. Timmerer, "DeepStream: Video Streaming Enhancements Using Compressed Deep Neural Networks," IEEE TCSVT, 2025.

Bitrate Ladder Construction

CPU vs GPU devices

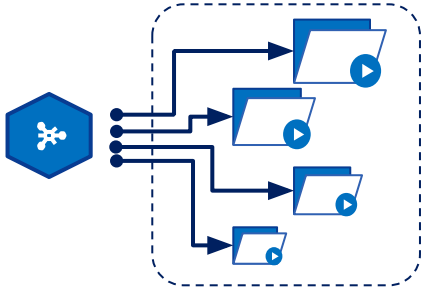


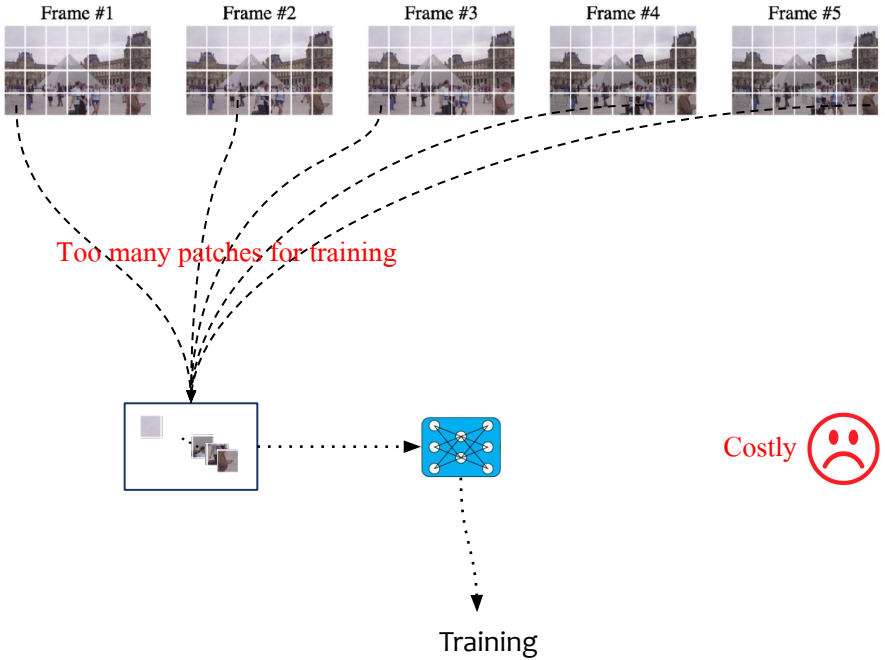


Y. Wei, H. Amirpour, J. H. Ko and C. Timmerer, "EPS: Efficient Patch Sampling for Video Overfitting in Deep Super-Resolution Model Training," IEEE TCSVT, 2026.

Bitrate Ladder Construction

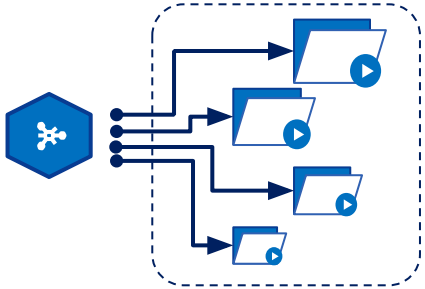
CPU vs GPU devices

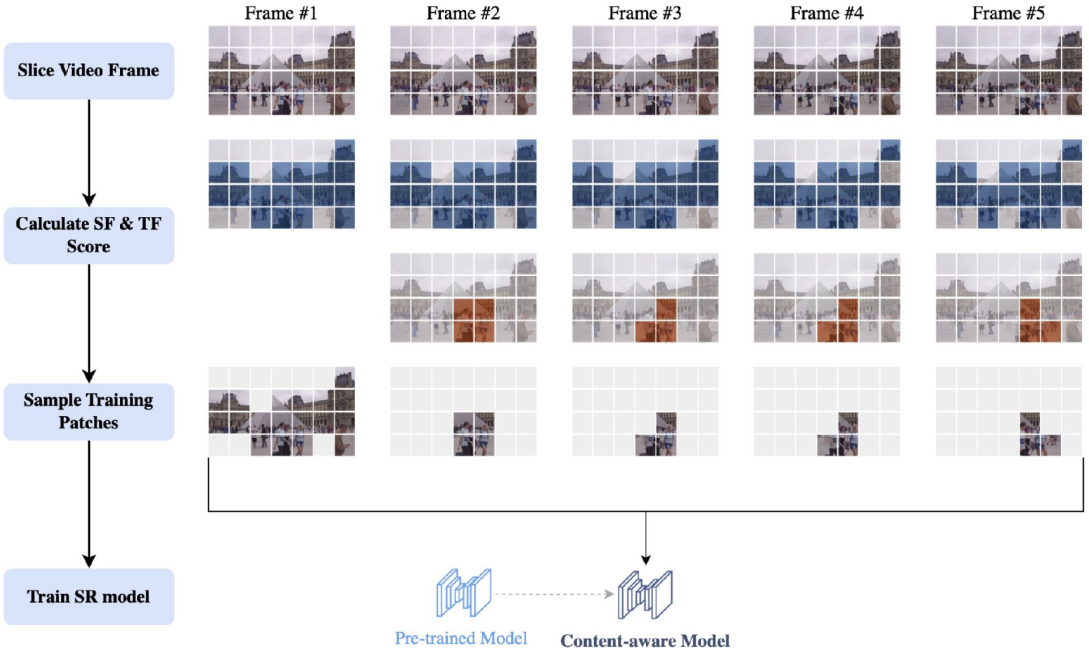




Bitrate Ladder Construction

CPU vs GPU devices



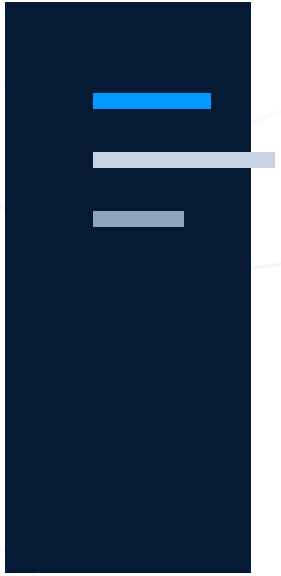


We select only informative patches for training

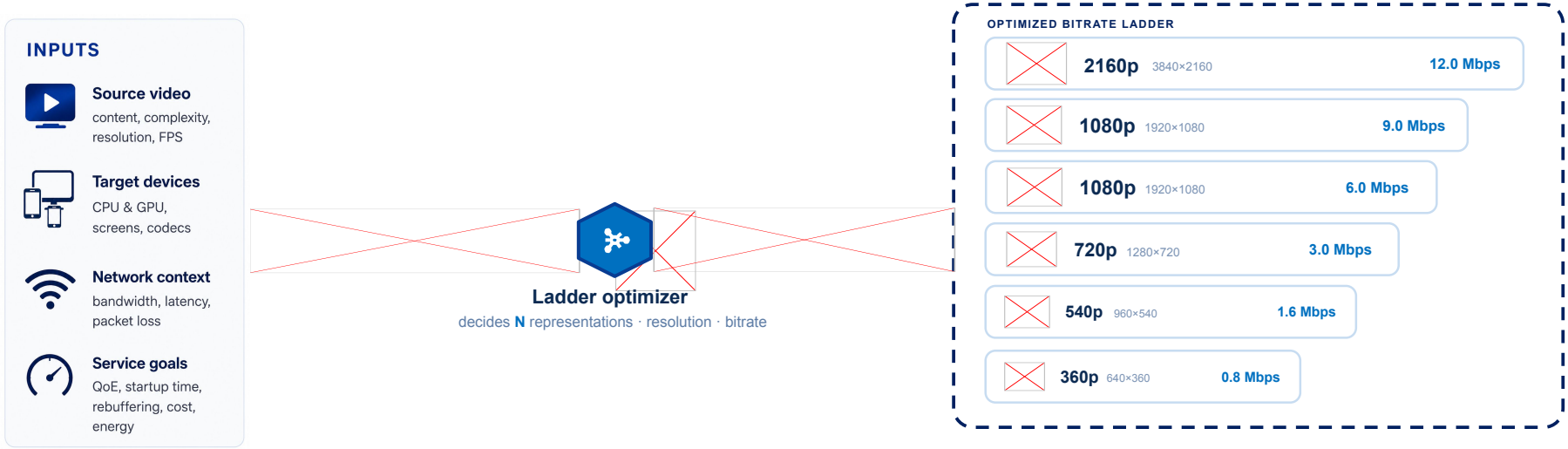


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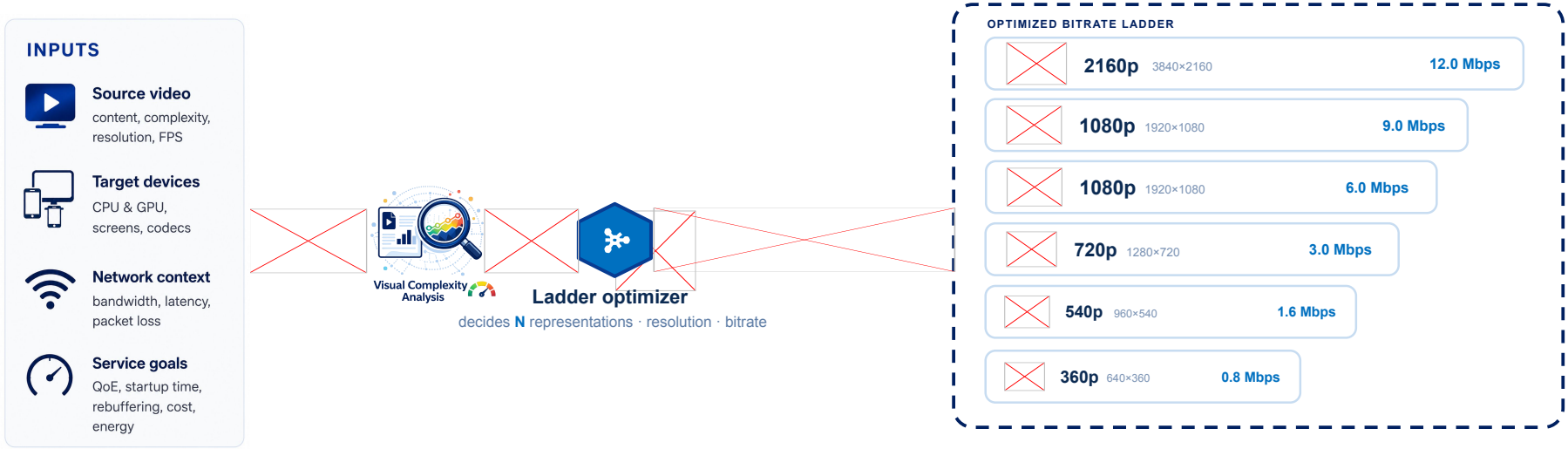
Visual Complexity Analysis



Optimizing the bitrate ladder

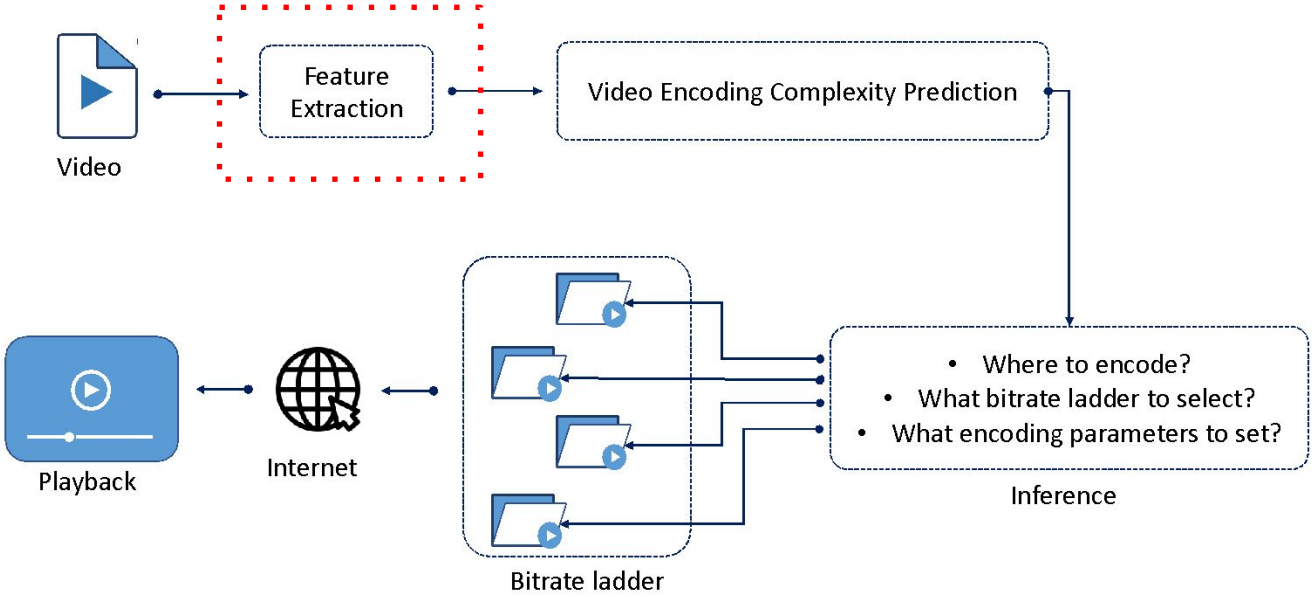


Optimizing the bitrate ladder



Bitrate Ladder Construction

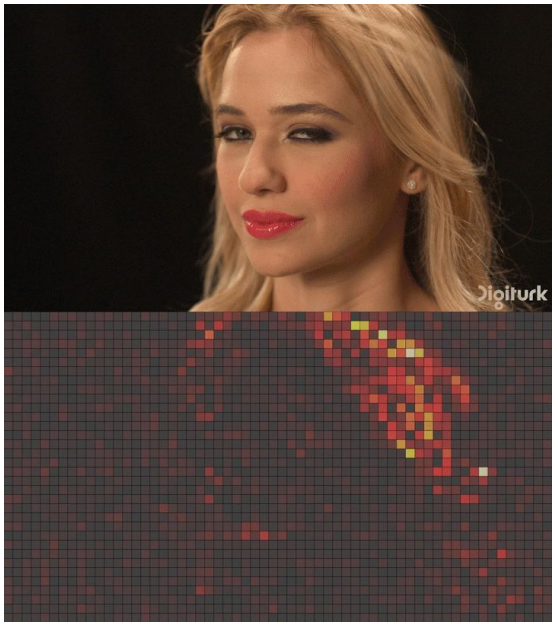
Feature Extraction for Live Video Streaming



Spatial and Temporal Complexity Features



Spatial Complexity (E)

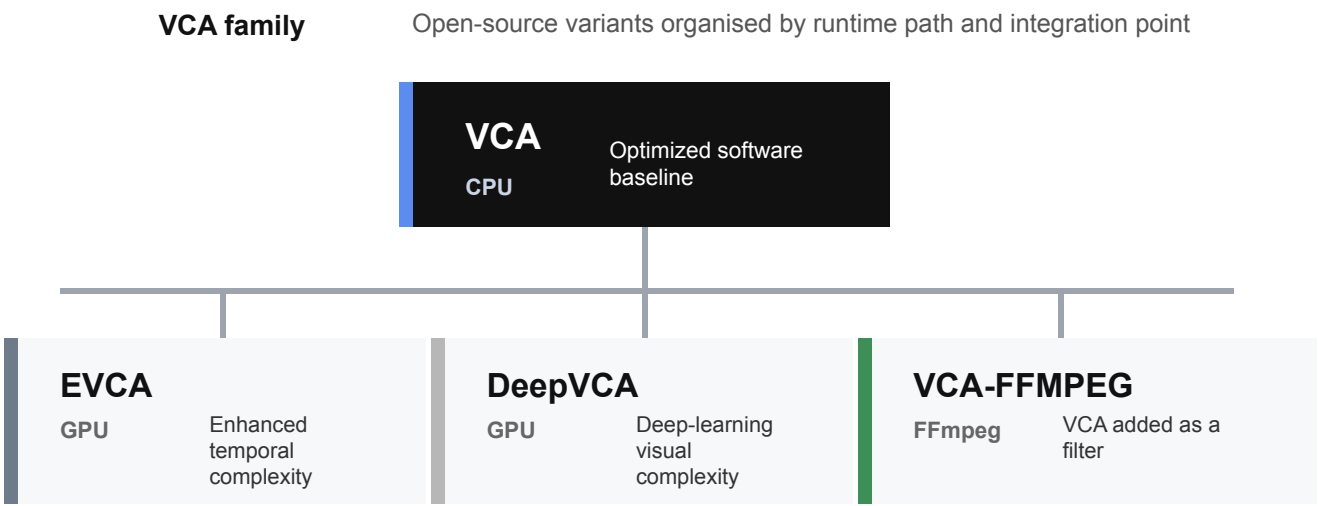


Temporal Complexity (h)

V. V. Menon, C. Feldmann, H. Amirpour, M. Ghanbari and C. Timmerer, "VCA: Video Complexity Analyzer," ACM MMSys, 2022.

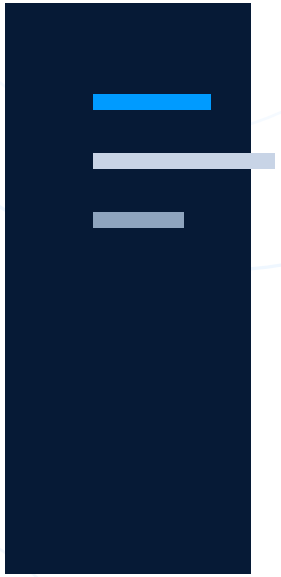
Bitrate Ladder Construction

Open-source software



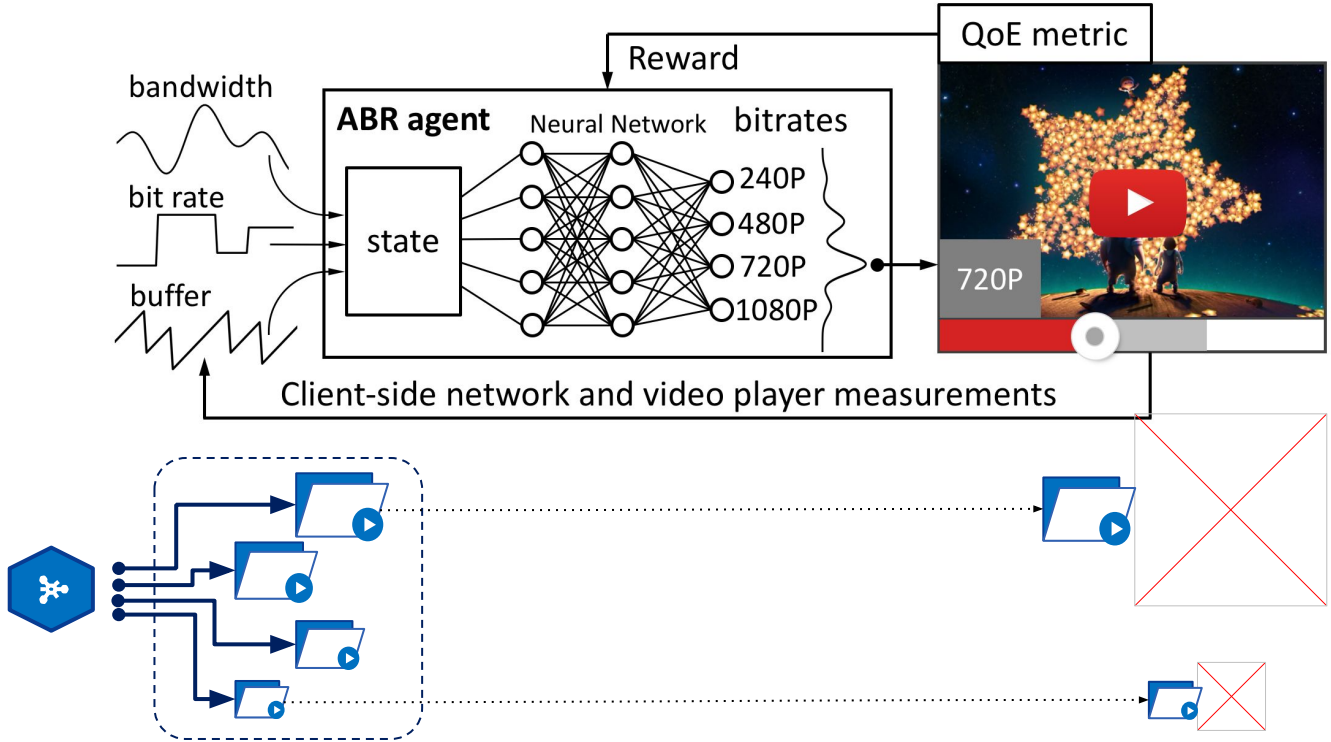
H. Amirpour, K. Schoeffmann, M. Ghanbari and C. Timmerer, "DeepVCA: Deep Video Complexity Analyzer," IEEE TCSVT, 2024.

Quality of Experience



Quality of Experience

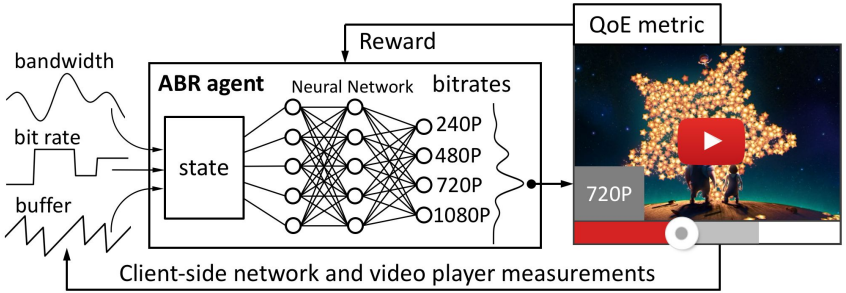
FFmetric: Perceptual Quality Prediction from Encoder Statistics

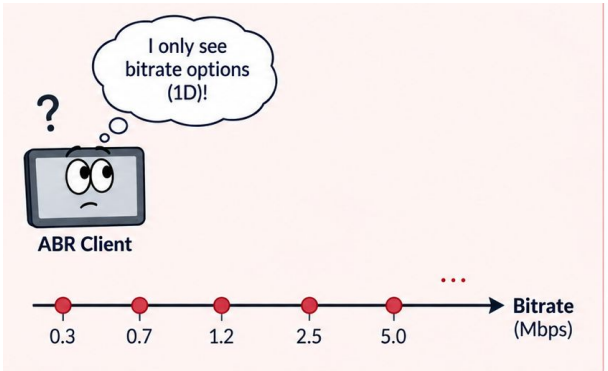


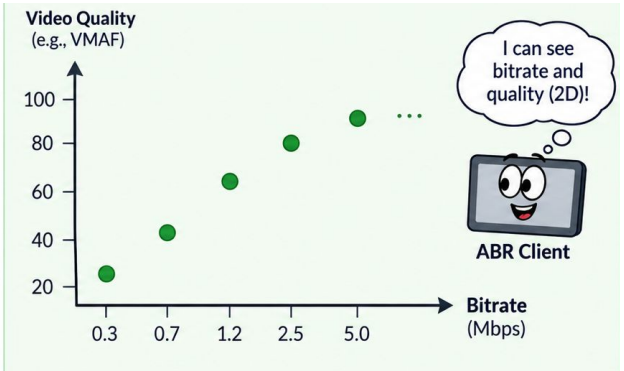
H. Mao, R. Netravali and M. Alizadeh, "Neural Adaptive Video Streaming with Pensieve," ACM SIGCOMM, 2017.

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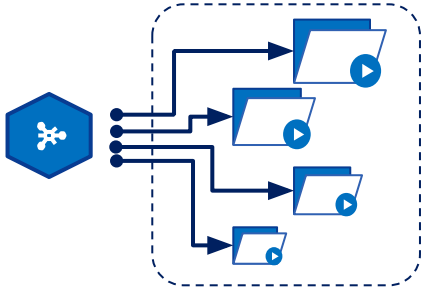




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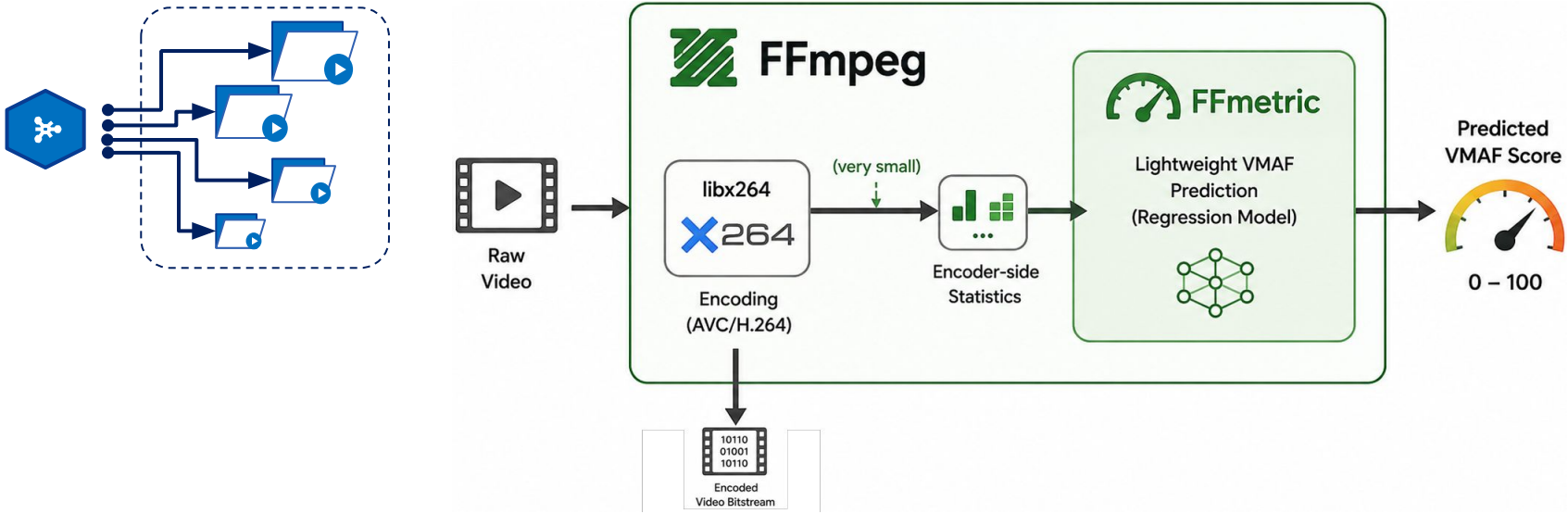


```
frame I:1     Avg QP:23.38  size:419595
frame P:26    Avg QP:23.58  size: 78520
frame B:33    Avg QP:27.42  size:  6417
consecutive B-frames: 25.0%  3.3%  5.0% 66.7%
mb I  I16..4:  4.8% 56.4% 38.9%
mb P  I16..4:  0.2%  0.6%  0.6%  P16..4: 37.5% 19.6% 19.9%  0.0%  0.0%    skip:21.6%
mb B  I16..4:  0.0%  0.1%  0.0%  B16..8: 35.6%  2.6%  1.0%  direct: 1.1%  skip:59.5%  L0:43.3% L1:48.9% BI: 7.8%
8x8 transform intra:52.9% inter:53.9%
coded y,uvDC,uvAC intra: 82.2% 79.5% 42.2% inter: 19.8% 11.7% 0.6%
i16 v,h,dc,p: 20% 33% 15% 33%
i8 v,h,dc,ddl,ddr,vr,hd,vl,hu: 13% 21% 26%  6%  7%  5%  8%  5% 10%
i4 v,h,dc,ddl,ddr,vr,hd,vl,hu: 22% 20% 11%  5% 10%  7% 10%  6%  8%
i8c dc,h,v,p: 48% 26% 21%  5%
Weighted P-Frames: Y:0.0% UV:0.0%
ref P L0: 67.5% 16.4% 10.8%  5.2%
ref B L0: 86.2%  9.7%  4.1%
ref B L1: 92.4%  7.6%
kb/s:10691.52
```

H. Amirpour, J. Zhu, W. Zhou, P. Le Callet and C. Timmerer, "VQM4HAS: A Real-Time Quality Metric for HEVC Videos in HTTP Adaptive Streaming," IEEE TMM, 2025.

Quality of Experience

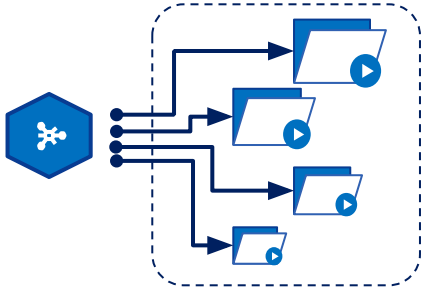
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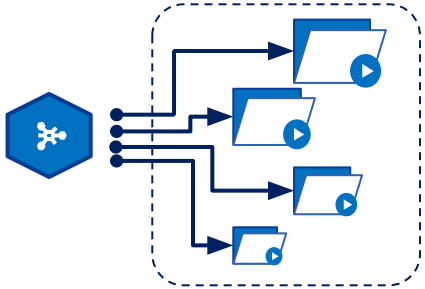


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mb B  I16..4:  0.0%  0.1%  0.0%  B16..8: 35.6%  2.6%  1.0%  direct: 1.1%  skip:59.5%  L0:43.3% L1:48.9% BI: 7.8%
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Weighted P-Frames: Y:0.0% UV:0.0%
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Quality of Experience

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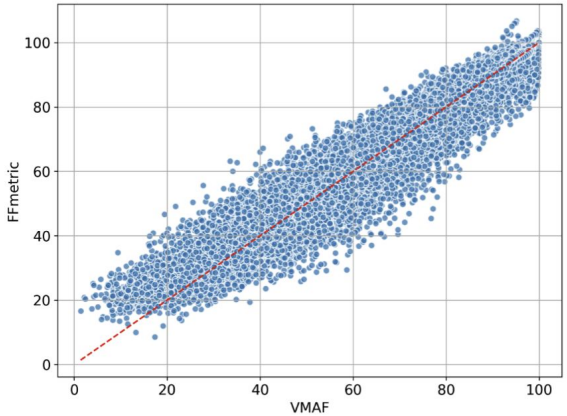


Figure 3: Ground-truth VMAF scores and FFmetric predictions on the unseen test set.

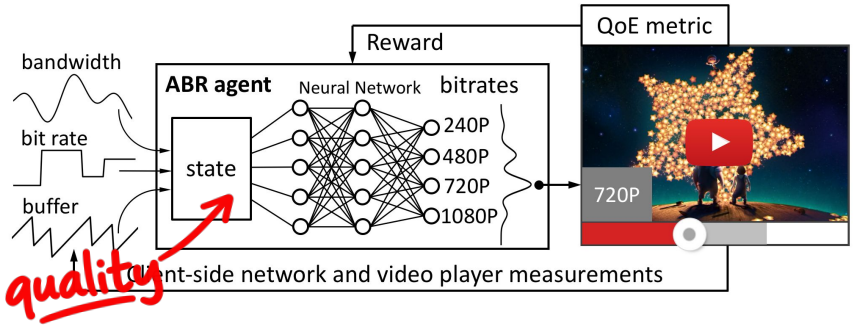
Table 1: Performance of the proposed FFmetric XGBoost model on the unseen test set.

Model	R^2	PLCC	SRCC	MAE	RMSE
FFmetric	0.96	0.98	0.97	2.87	4.19

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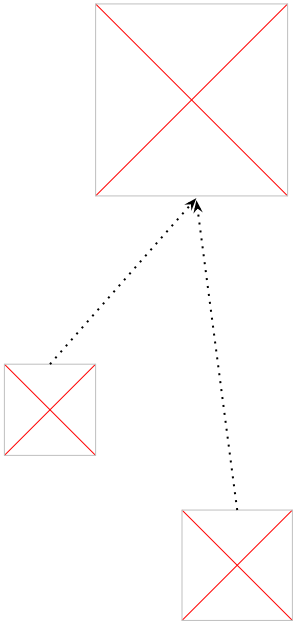
Quality of Experience

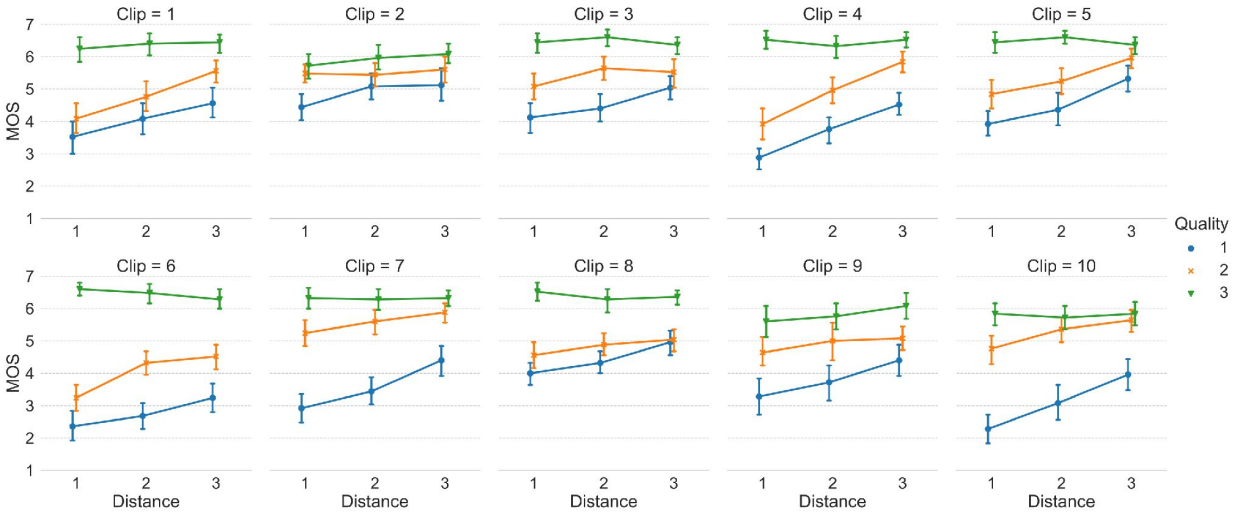
FFmetric: Perceptual Quality Prediction from Encoder Statistics



Quality of Experience

Impact of Viewing Distance [**In-Lab** Subjective Test]





Beyond 2D

Spatial video, immersive interaction and **stereoscopic quality**



Spatial Video Dataset (SVD)
Spatial scenes, ACM MM 2025



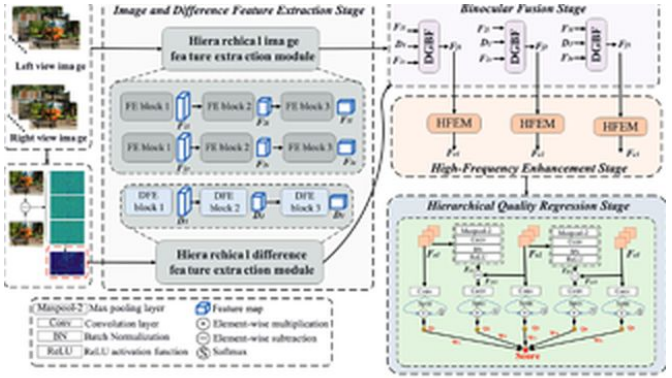
Interactive Spatial Darts
Hand-tracked AR darts (SDART)



STACK Interaction
Tower-building on Apple Vision Pro



Spatial Video Quality
2D vs. stereoscopic viewing on AVP



Stereo Image Quality Assessment
Image/difference feature fusion

THANK YOU

