Performance Evaluation of Existing Quality Models and ITU Standards on Video Gaming Quality Estimation
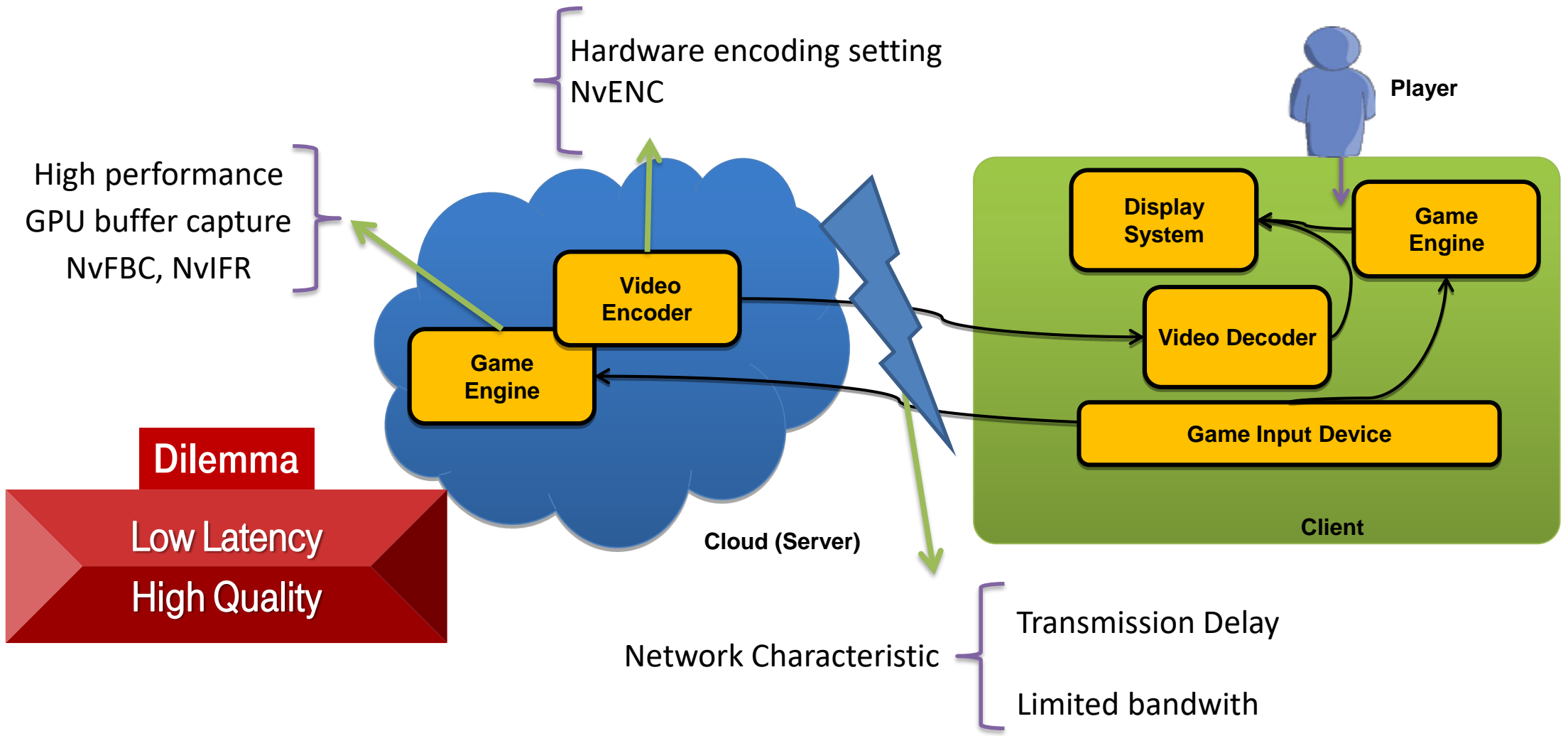
VQEG Meeting - Mountain View, California, USA, 2018

Saman Zadtootaghaj

LIFE IS FOR SHARING.

CLOUD GAMING

Hardware encoding setting
NvENC

High performance
GPU buffer capture
NvFBC, NvIFR

Dilemma

Low Latency

High Quality

Player

Display System

Game Engine

Video Encoder

Video Decoder

Game Engine

Game Input Device

Cloud (Server)

Client

Network Characteristic

Transmission Delay

Limited bandwith

CLOUD GAMING
Special encoding and network protocol

❑ **Latency**

   ❑ Capturing RGB data from frame buffer (front buffer) without any involvement from OpenGL/Direct3D

   ❑ Using GPU hardware accelerator engines for video encoding/decoding

   ❑ Fixed macroblock size for fast encoding

❑ **Packet loss (concealment)**

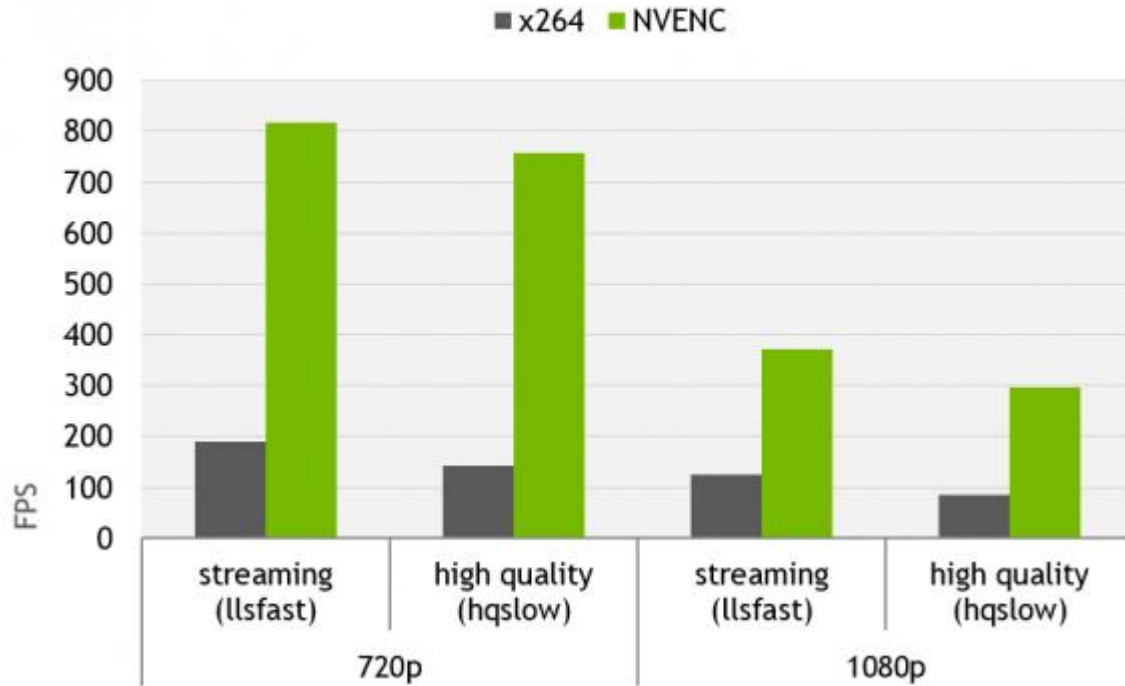   ❑ Designing task-specific network protocol such as reliable UDP

❑ **Encoding setting**

   ❑ CBR, short GoP, ...
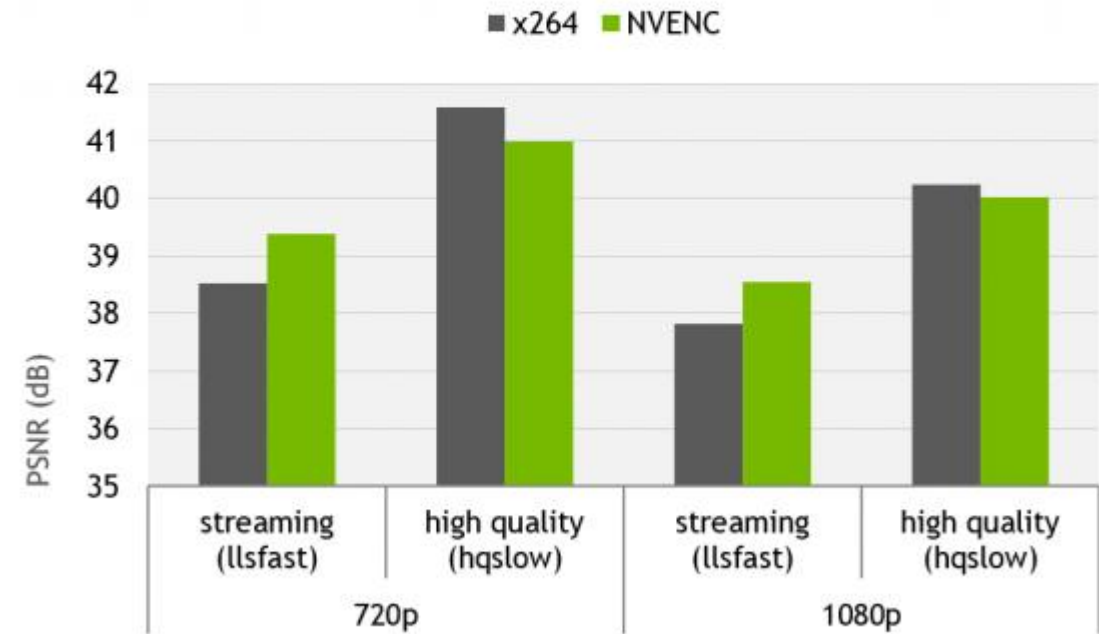
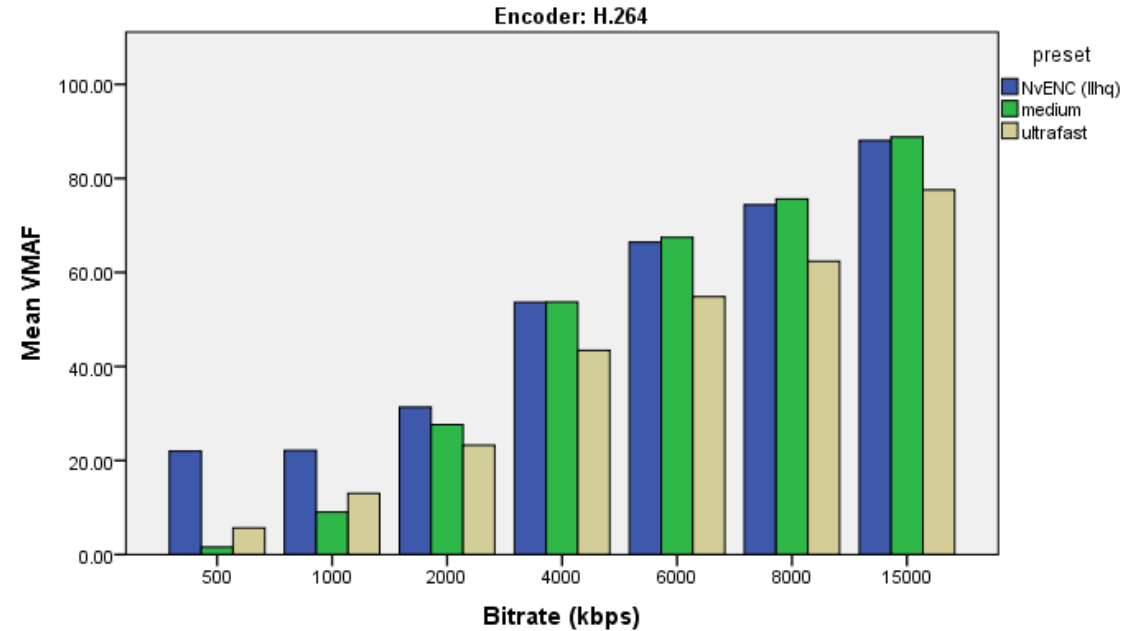# HW VS SW ENCODING
NVENC vs x264

Video Encode Performance
x264 ■ NVENC ■

Quality comparable to x264
x264 ■ NVENC ■

Taken from https://developer.nvidia.com/nvidia-video-codec-sdk

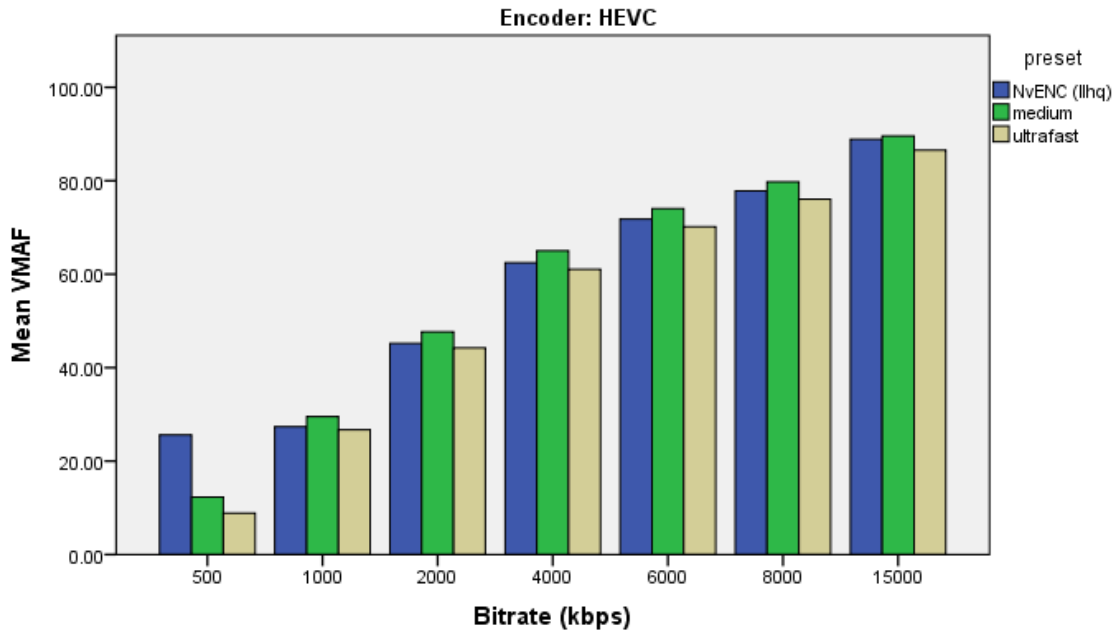**Performance evaluation of existing quality models and ITU standards on video gaming quality estimation**

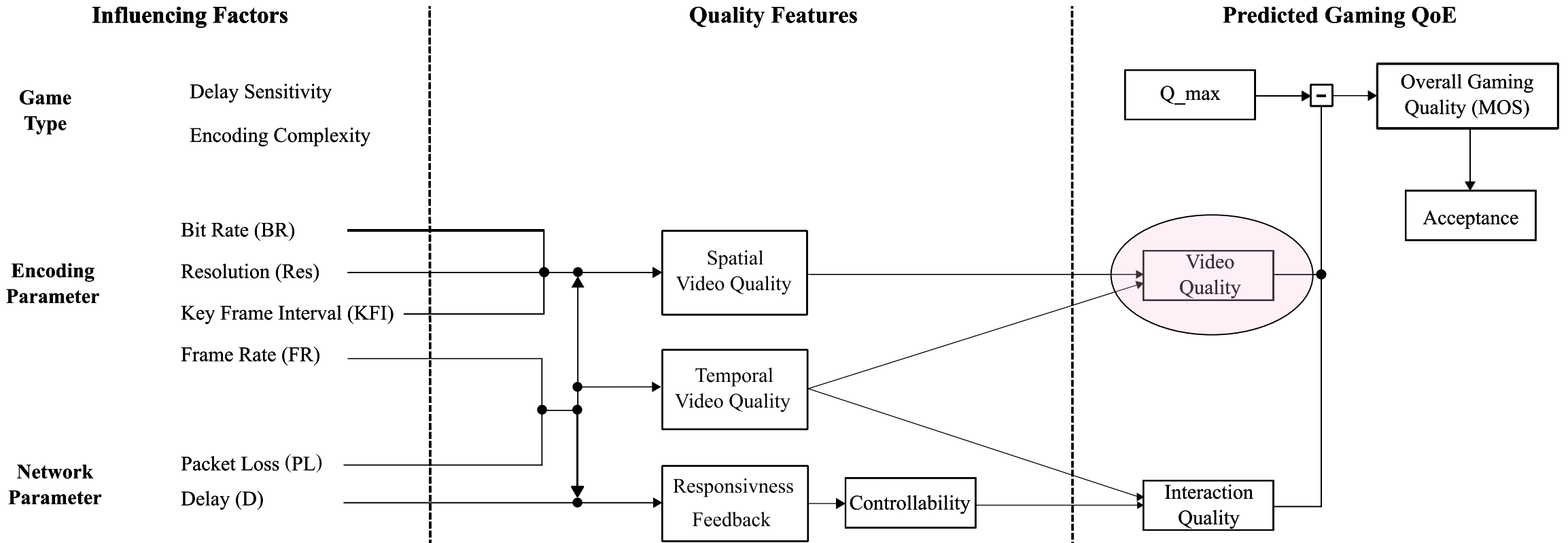# HW VS SW ENCODING
NVENC vs x265/x264

The result for a complex video game: Nier Automata

Medium preset of x264 performs quite similar to llhq preset of NvENC

G.OMG MODEL
Opinion model for gaming

Influencing Factors

Game Type
- Delay Sensitivity
- Encoding Complexity

Encoding Parameter
- Bit Rate (BR)
- Resolution (Res)
- Key Frame Interval (KFI)
- Frame Rate (FR)

Network Parameter
- Packet Loss (PL)
- Delay (D)

Quality Features

- Spatial Video Quality
- Temporal Video Quality
- Responsivness Feedback
- Controllability

Predicted Gaming QoE

- Q_max
- Overall Gaming Quality (MOS)
- Acceptance
- Video Quality
- Interaction Quality

VIDEO QUALITY MODELS
Standardization activities

❑ **Planning model**

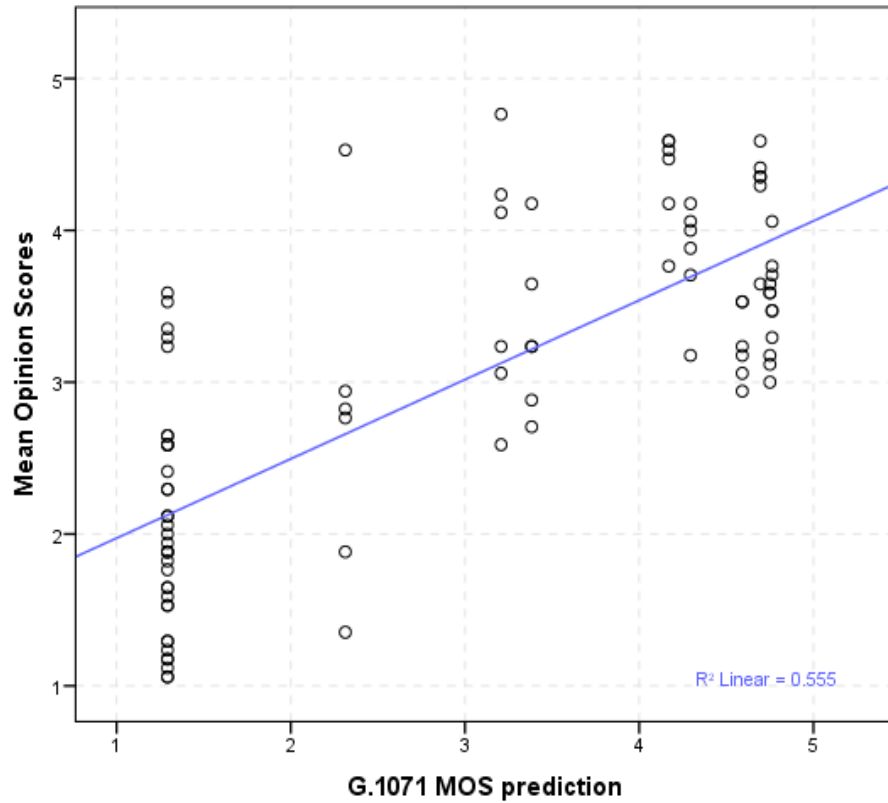 ❑ G.1071: Opinion model for network planning of video and audio streaming applications

❑ **Monitoring models**

  ❑ P.1201: Parametric non-intrusive assessment of audiovisual media streaming quality

  ❑ P.1203: Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport
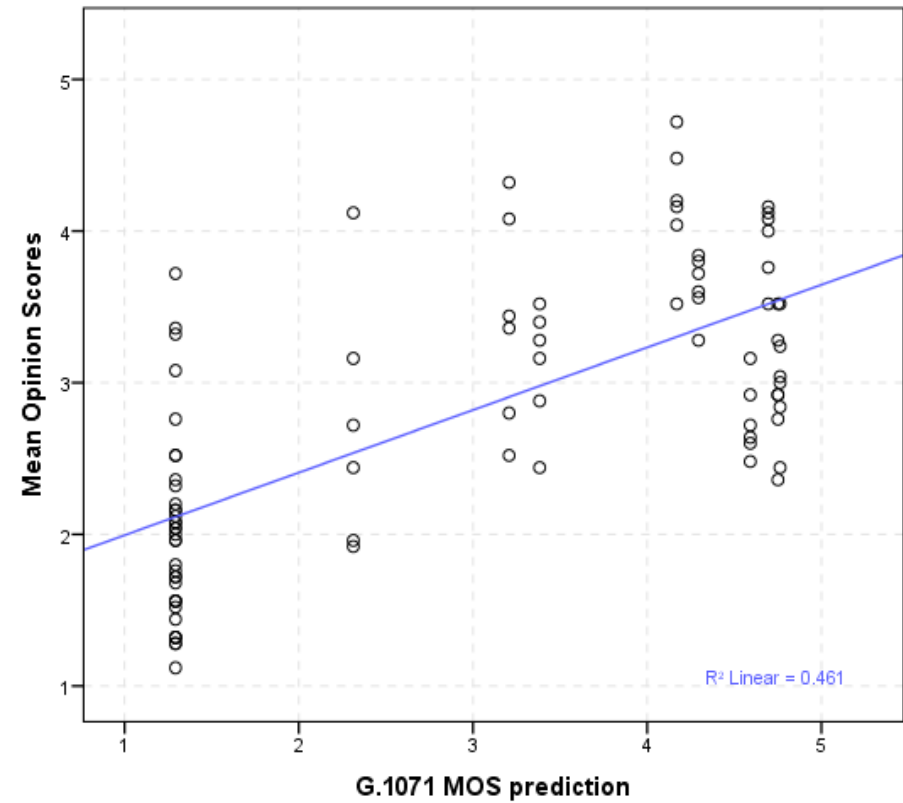
G.1071 ON VIDEO GAMES
Planning Video Gaming Model
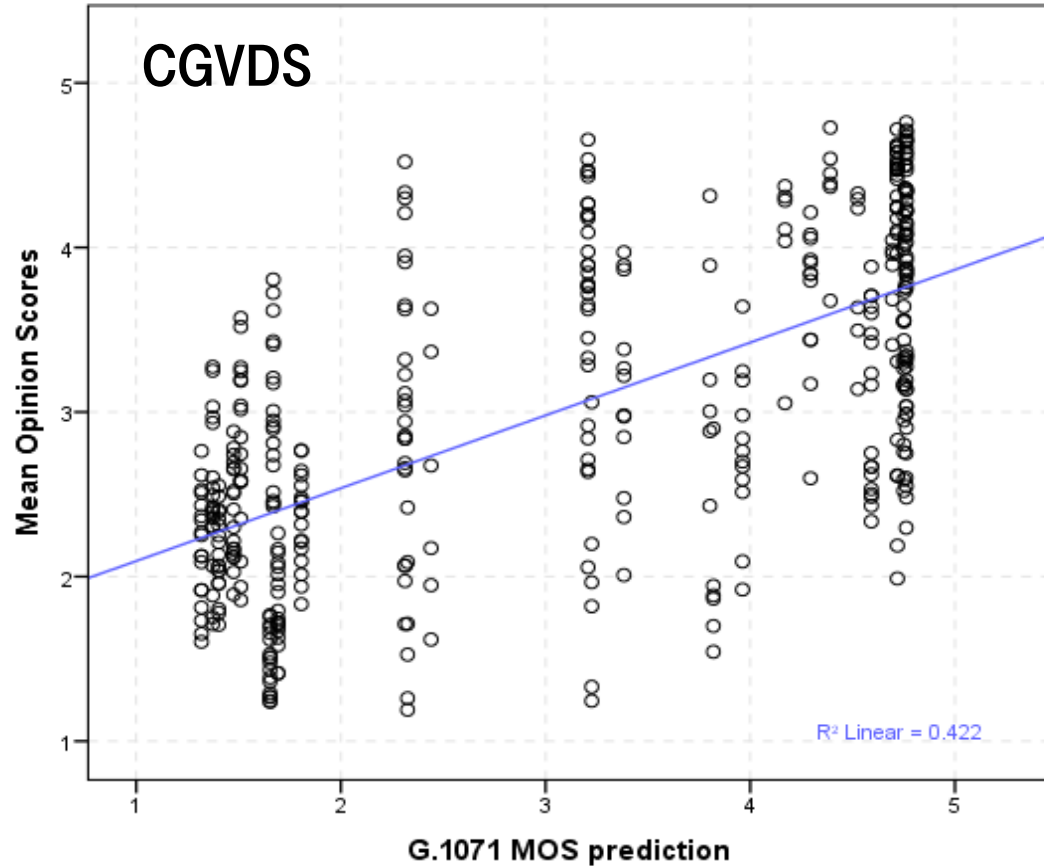
GamingVideoDataset

KUGVD

Performance evaluation of existing quality models and ITU standards on video gaming quality estimation

G.1071 ON VIDEO GAMES
Planning Video Gaming Model

CGVDS

R^2 Linear = 0.422

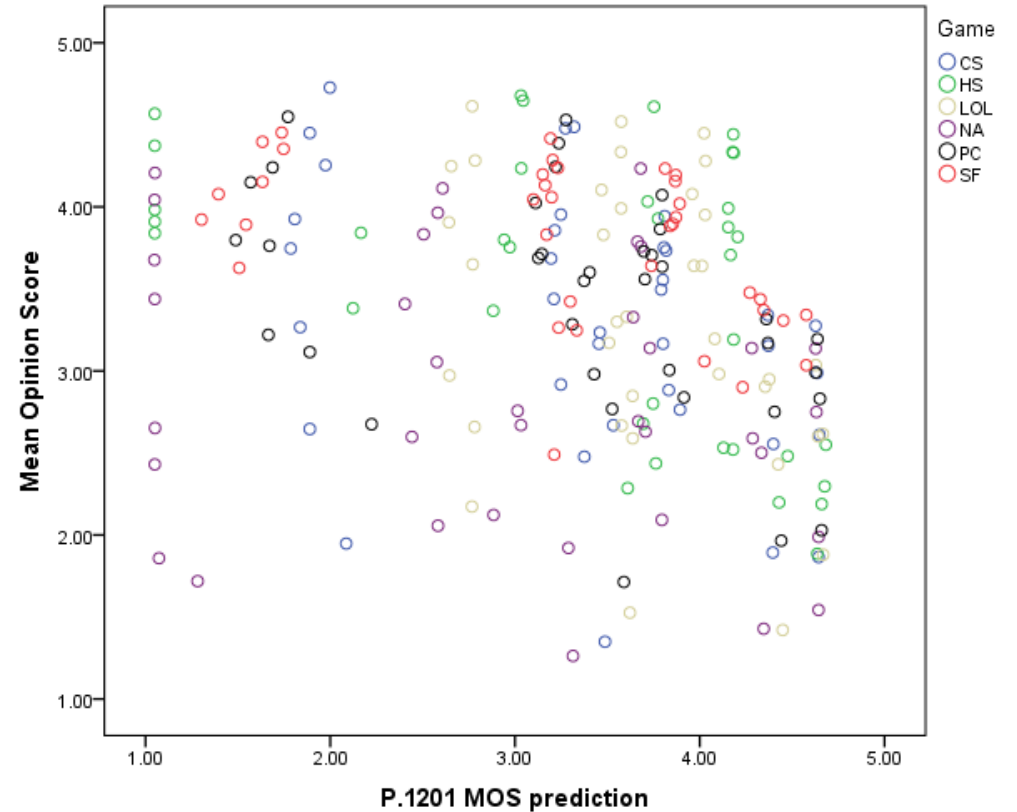| GamingVideoDataSet		KUGVD		CGVDS	
Correlation	RMSE	Correlation	RMSE	Correlation	RMSE
0.68	1.1	0.74	0.99	0.65	1.05

P.1201 ON VIDEO GAMES
Observation

❏ **P.1201 did not perform well with our dataset**

Possible reasons:

❏ **Not trained well enough for gaming content**

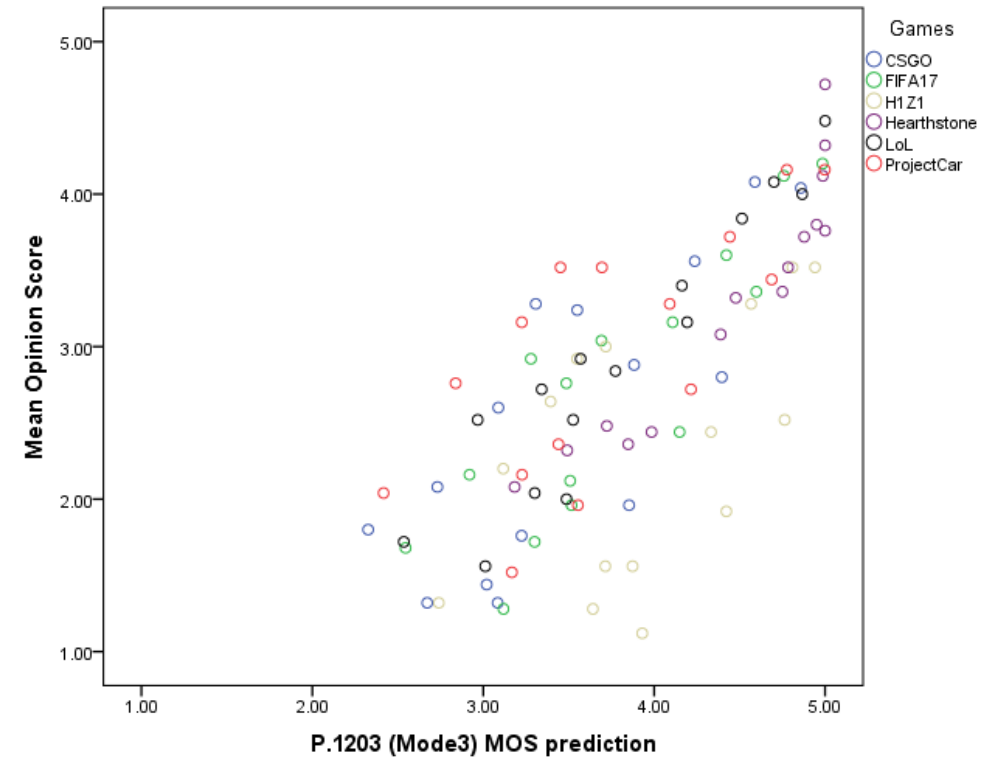❏ **Diversity of video complexity of selected video sequences**

❏ **Usage of GPU encoding**

RESULTS OF P.1203

Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport

Mode	Encryption	Input	Complexity
0	Encrypted media payload and media frame headers	Meta-data	Low
1	Encrypted media payload	Meta-data and frame size/type information	Low
2	No encryption	Meta-data and up-to 2% of the media stream	Medium
3	No encryption	Meta-data and any information from the video stream	Unlimited

RESULTS OF P.1203

Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport
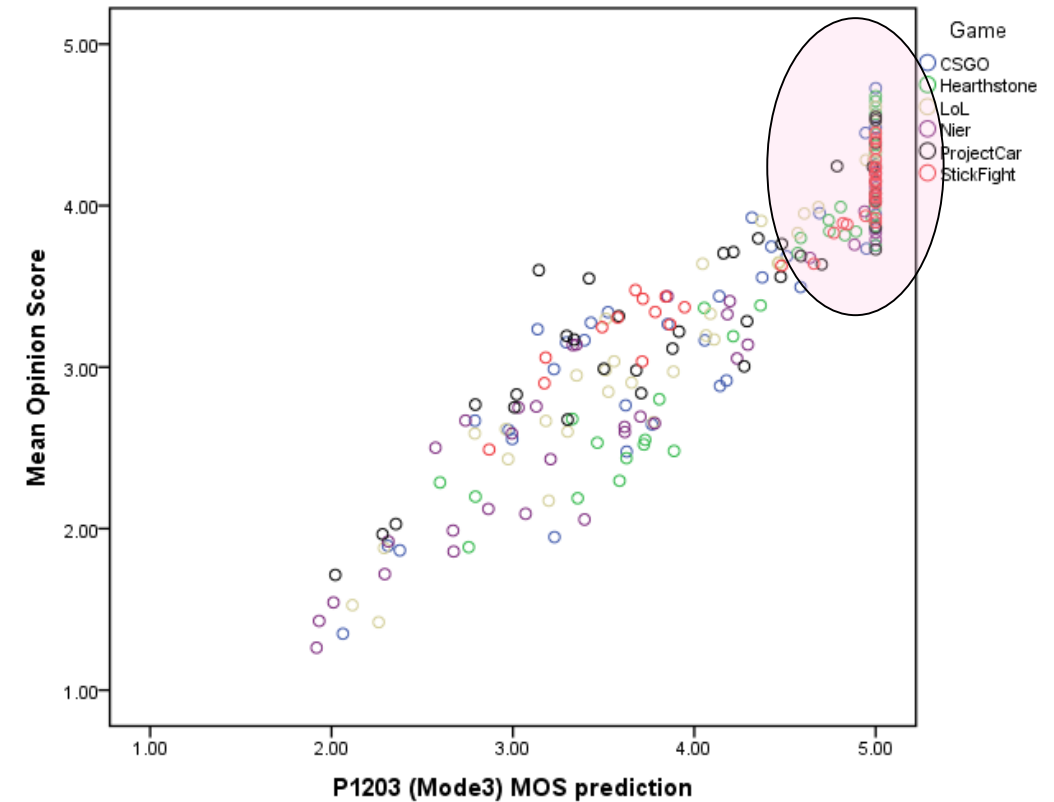
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G.OMG VIDEO QUALITY
Updating G.1071 based on gaming content

- ☐ **Fit the model again based on our dataset**
  - ☐ Only a few coefficients changed dramatically

- ☐ **The change of performance after fitting wiht the new dataset**
  - ☐ SRCC: 0.63 ➔ 0.735
  - ☐ RMSE: 1.05 ➔ 0.754

Coefficient	old		new
a_{1V}	51.28	$\rightarrow$	65.74
a_{2V}	−22.00	$\rightarrow$	−15.68
a_{3V}	6.00	$\rightarrow$	7.42
a_{4V}	6.21	$\rightarrow$	12.46
a_{31}	3.92	$\rightarrow$	−4.88
a_{32}	−27.54	$\rightarrow$	−16.70
a_{33}	0.26	$\rightarrow$	1.18
c_{1V}	17.73	$\rightarrow$	21.97
c_{2V}	123.08	$\rightarrow$	0.047
c_{21}	80.61	$\rightarrow$	198.88
c_{22}	0.000 46	$\rightarrow$	0.000 46
c_{23}	0.001 47	$\rightarrow$	0.000 70
q_1	0.018	$\rightarrow$	0.000 006 9
q_2	0.04	$\rightarrow$	0.10

CONCLUSION

❑ **Gaming content is diverse in terms of video complexity**
  ❑A video game classification is required in order to obtain an accurate video game model

❑ **G.OMG**
  ❑Updating G.1071 for gaming content might be a candidate for video quality module
  ❑We plan to extend our dataset to cover wide range parameters

❑ **P.1203 phase 2**
  ❑Recommend to use gaming content in training process and especially high complex video games as they might be much more complex than non-gaming videos

Thank you for your attention!

Visit www.qu.tu-berlin.de for more information.