Techniques for Measuring QoE

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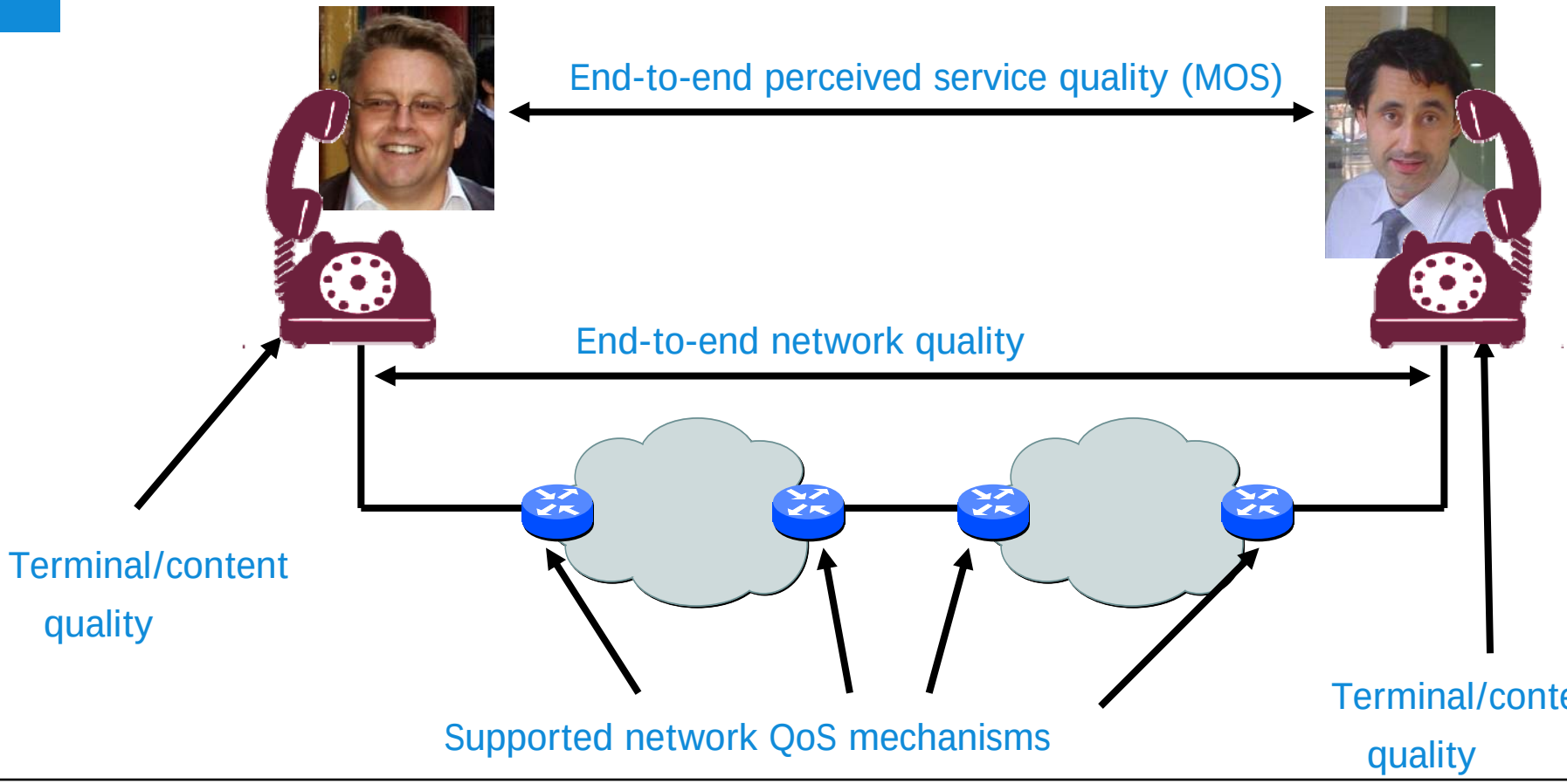
Outline

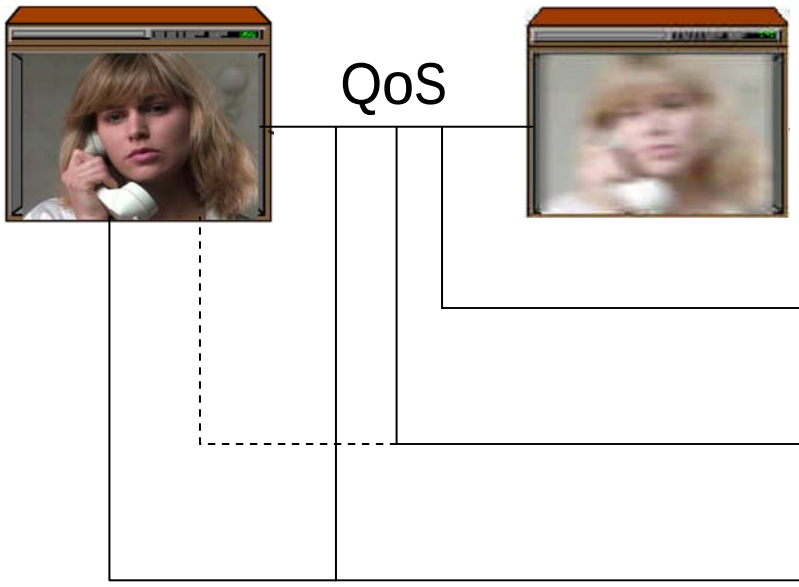
ITU-T FG IPTV: Quality of Experience (QoE) refers to the overall acceptability of an application or service, as perceived subjectively by the user.

- QoE in perspective
- QoE of speech and audio
- QoE of gaming
- QoE of video
- QoE as design parameter

QoE in perspective

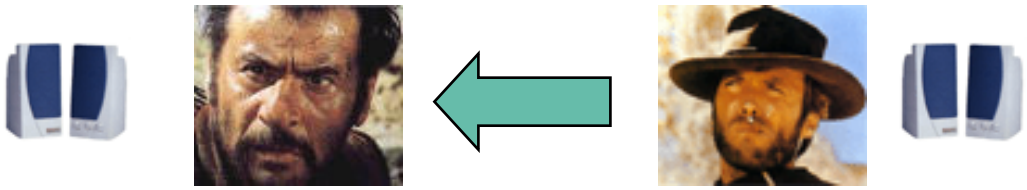


QoE measurement methodologies



- No-reference model
- Reduced-reference model
- Full-reference model

No-reference E-model (speech)



$R = R_0 - I_s - I_d - I_e + A$

R_0: SNR

I_s: Speech signal

I_d: Delay

I_e: Equipment

A: Advantage

	A	B	C	D	E
1	**E-model according to updated Appendix/I G.113**				
2					
3	EchoLoss [dB]		codec	delay [ms]	loss
4	65		G.729	100	5.00%
5					
6					
7					
8	**MOS**				
9	**3.34**		**GSM quality**		
10					

Full-reference model speech & audio

- Full-reference speech: PESQ - ITU-T Rec. P.862
- Full-reference audio: PEAQ - ITU-R BS.1387

- Excerpts of reference and test signal are aligned and compared

- Tools:
  - Peaqb
  - PQeval Audio

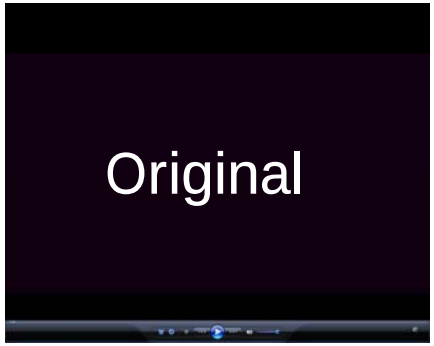
QoE of gaming

- First Person Shooter games (Quake IV)

- No-reference G-model:

$$MOS = \max(4.33 - 3.08*10^{-9}X^3 + 1.18*10^{-5}X^2 - 1.15*10^{-2}X, 1)$$
$$X = \min(AVGRTT + 0.686*JITTER, 650)$$

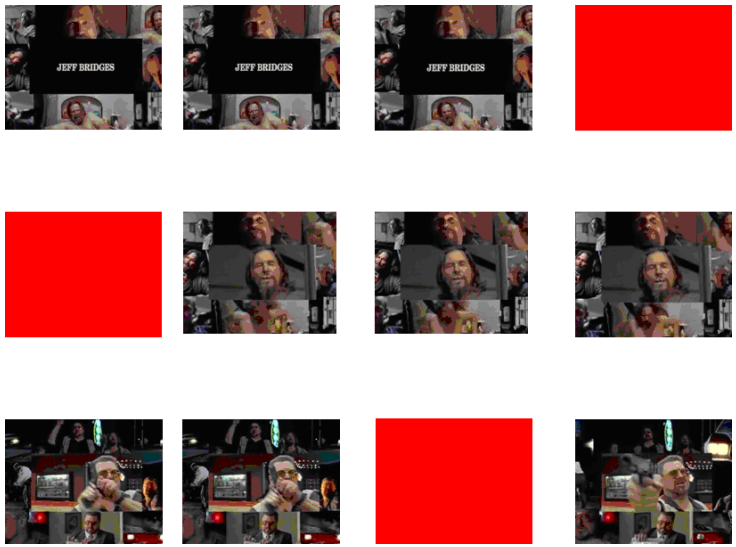
QoE of video – Visual quality

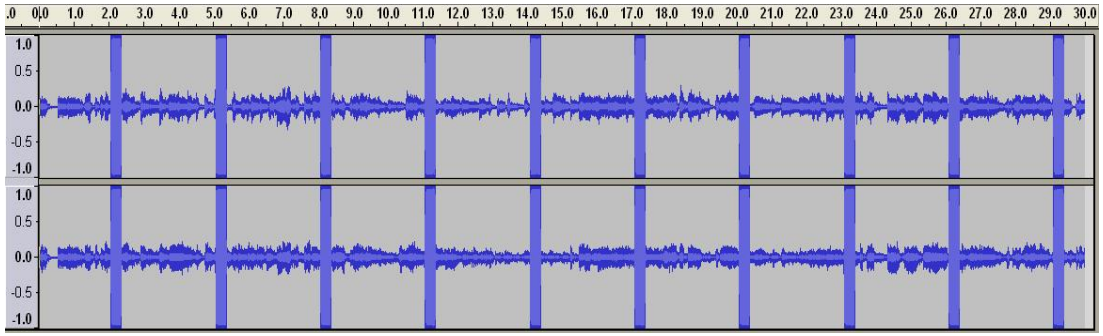


- Video quality metrics (Full Reference):
  - PSNR (ratio in dB between signal power of original signal versus power of reconstructed compressed signal)
  - VQM (software tool by ITS)
- Calibration is key
- No standards for no-reference models

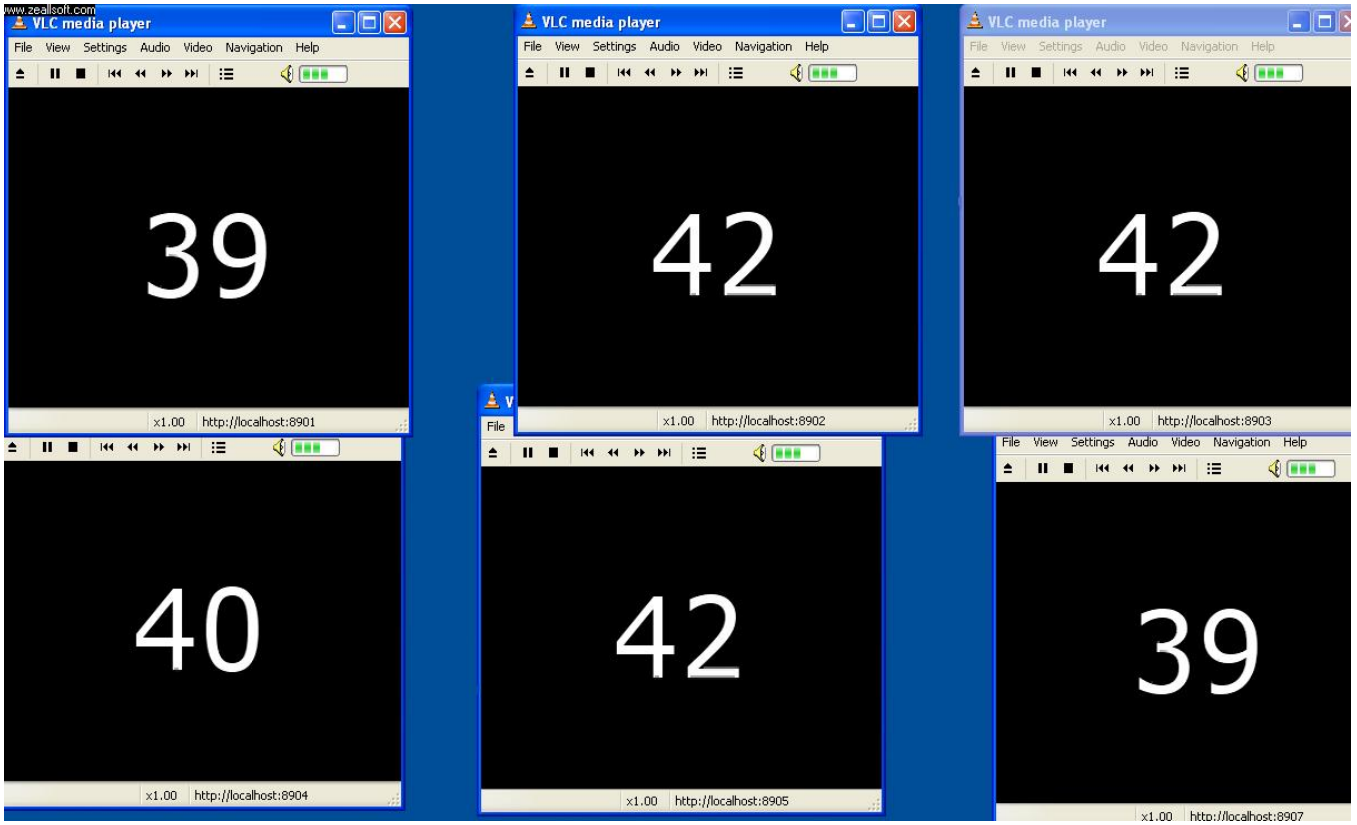
QoE of video – A/V synchronization

- ITU-R Rec. BT.1359-1: no more than 90 ms audio leading video and no more than 185 ms audio lagging behind video





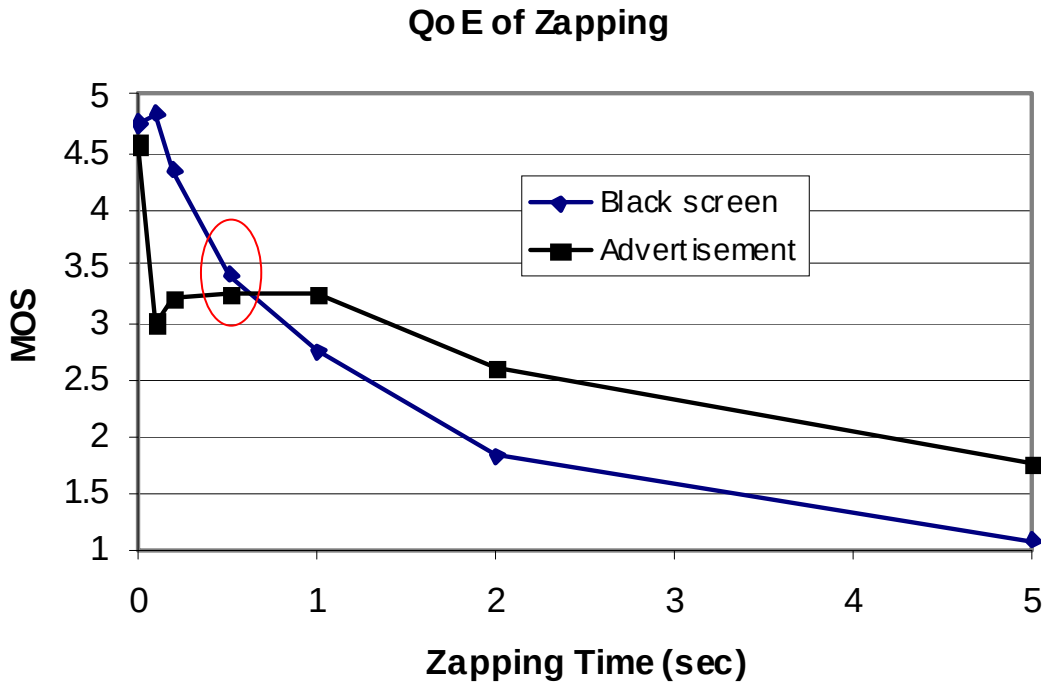
QoE of video – User synchronization



QoE of video – Zapping time

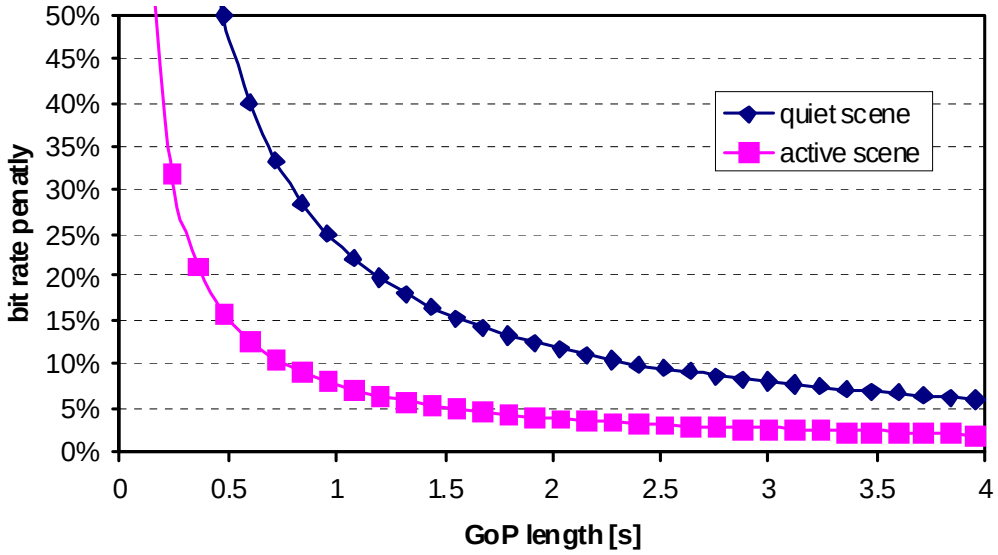
Experiments

SopCast: 50 s



QoE as design parameter – IPTV case

- Determine quality TV signal (visual quality)
- Desired quality impacts required bit rate (I-frame spacing)
- Zapping < 0.5 s for MOS 3.5



QoE Trends in Networking

- No-reference models for streaming services
- QoE as design parameter
- ...