Recent results on adaptive streaming

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OBJECTIVE

- Performing a subjective experiment to evaluate the Quality of Experience of adaptive video streaming
- Evaluate crowdsourcing as a method for performing subjective experiments

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STUDY FACTORS

- Adaptive streaming by decreasing the video bitrate and rebuffering events
- Constant bitrate
  - H.264/AVC
  - Video Bitrate: 5Mbps, 3Mbps, 1Mbps, 600kbps
- Adaptation event
  - Rapid decreasing quality
  - Gradual decreasing quality
- Rebuffering events
  - 1 or 2 rebuffering total time 2 sec

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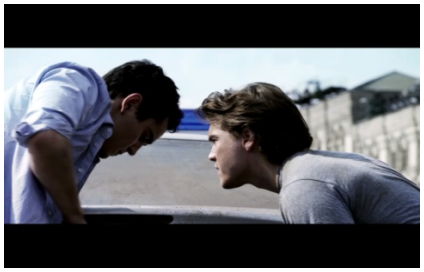
VIDEO CONTENT TYPES

Source videos in1280x720, 24 fps

Video	Characteristics
Movie 1	Action, some scene in smooth motion, some with groups of walking people, some camera panning
Movie 2	Drama, mostly with smooth motion in static background, some scene with groups of dancing people in bright ambient light
Movie 3	Action, Sci Fi, with cloudy skies
Documentary	Sport Doc., mostly with handheld camera
Sport	Soccer, average motion, with uniform camera panning
News	Spanish news, mostly static camera
Music	Music concert, extensive movement of the singer



ADAPTATION SCENARIOS

Code	Characteristic of scenarios
DGR2	Gradually decreasing the quality (5-3-1-600) with 2 seconds chunk
DRP2	Rapid decreasing the quality (5-600) with 2 seconds chunk
1F3M	1 Freezing event for 2 seconds in the constant 3 Mbps video
2F3M	2 Freezing events for 1 second each in the constant 3 Mbps video
1F1M	1 Freezing event for 2 seconds in the constant 1Mbps video
N5	No degradation- The whole segment at 5Mbps
N3	No degradation- The whole segment at 3Mbps
N1	No degradation- The whole segment at 1Mbps
N600	No degradation- The whole segment at 600kbps

TEST METHODOLOGY

- Crowdsourcing
  - Put out work assignments on microworker.com
  - 215 microworker in total
  - Task about 10 min
  - Pay ment 1 $
- Pair comparison
  - Compare video clips pairwise (ITU-T Rec. P.910)
  - Simple task for subject: “Which one do you prefer?”
  - Control question was inserted
  - Model exist to convert into quality scale (Bradley-Terry)
  - Number of combination grows quickly (Optimized square design)
  - 126 pairs in total, split into 14 different set of 9 video pairs with 3 contents and 3 degradations
  - Screentests was performed initially

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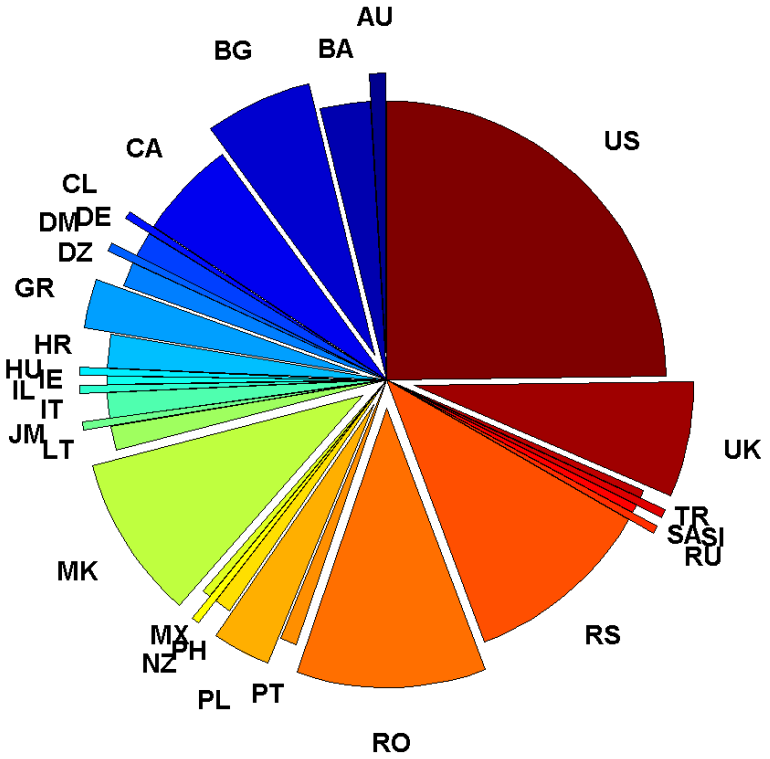
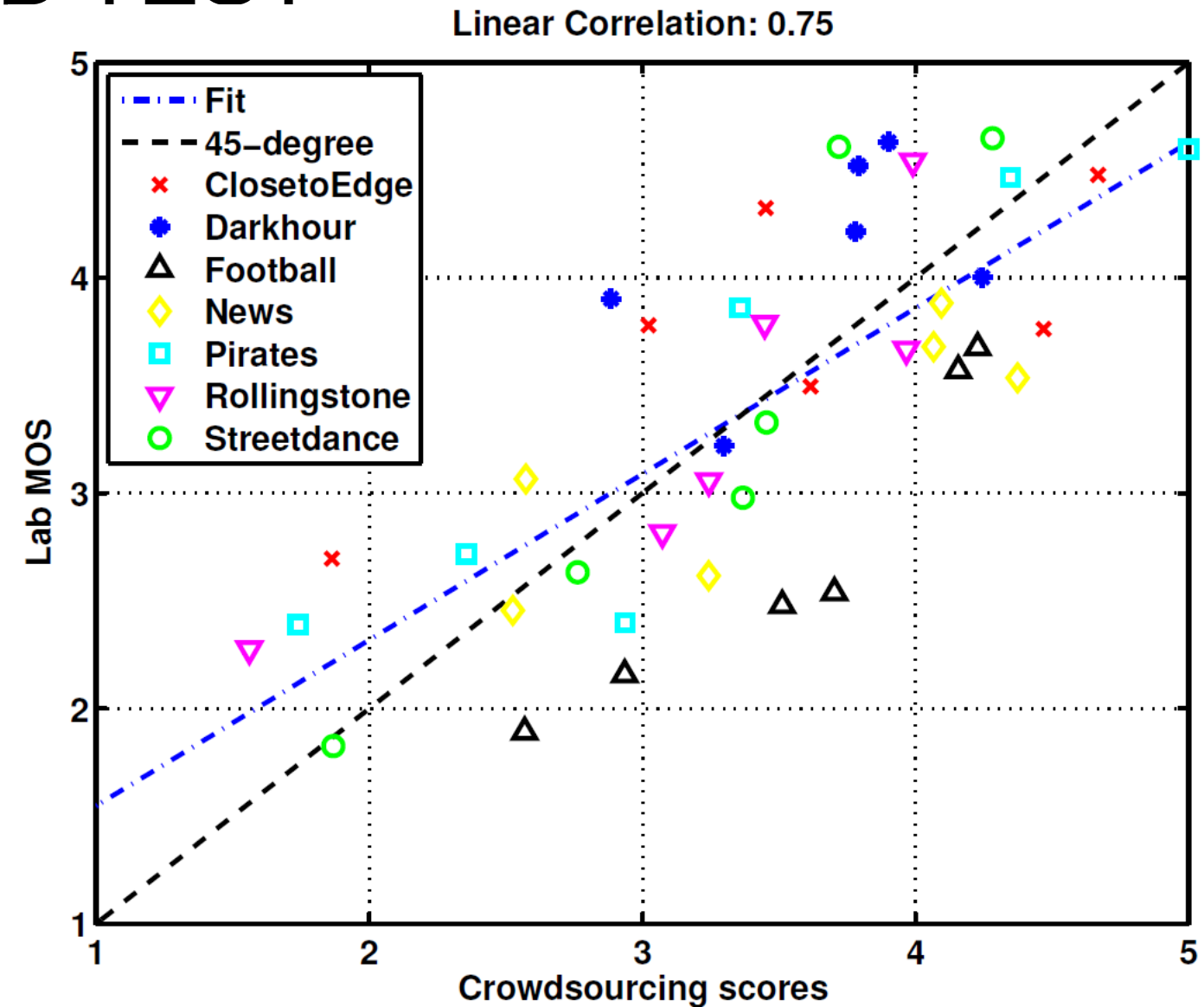
RESULTS

- First restricted to workers from US, UK, Canada, Australia, New Zealand
  - Very slow progress
- Restarted test for the whole world
  - Very fast progress



RESULTS – COMPARISON WITH LAB TEST



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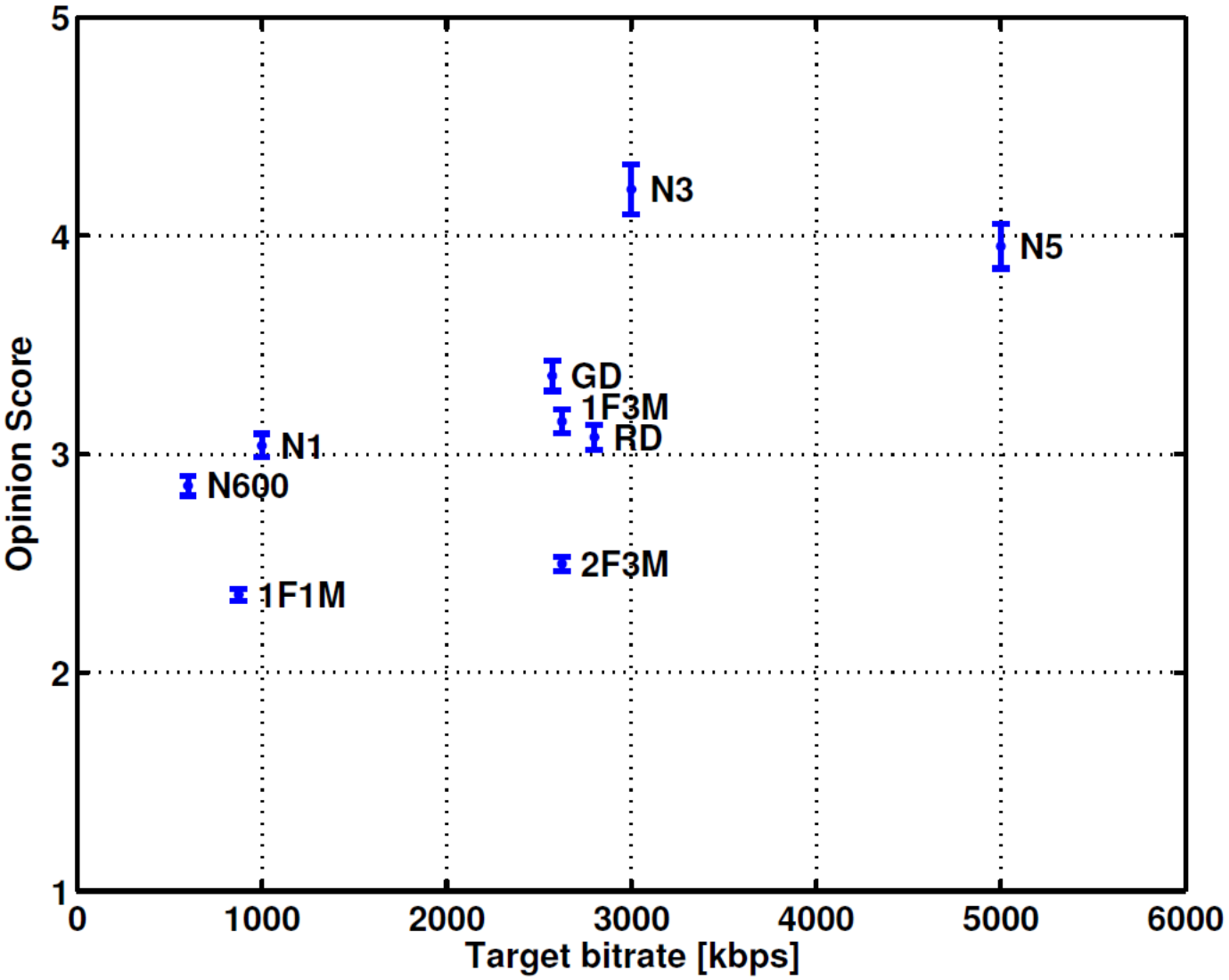
RESULTS – QUALITY VS BITRATE



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CONCLUSIONS

- Crowdsourcing test highly correlated to lab test
- Rebuffering lower quality in general
- Number of rebuffering events important
- 1 rebuffering at 3 Mbps same quality as the adaptive scenarios

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CONTENT CHARACTERIZATION

- The Lab test subjective design was not full-matrix
- How could then the results be understood?
- One way would be to characterize the PVS

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ADDITIONAL ANALYSIS OF LAB TEST

- Content characterization
  - Analysis of spatial- and temporal actitivity in the video (ITU-T Rec. P.910)

$$SI = max_{time}[std_{space}[sobel(f_n)]]$$

$$TI = max_{time}[std_{space}[M_n(i,j)]]$$

  - Divide into 4 cases:
    - Low Spatial – Low Temporal (LS-LT)
    - High Spatial – High Temporal (HS-HT)
    - High Spatial – Low Temporal (HS-LT)
    - Low Spatial – High Temporal (LS-HT)

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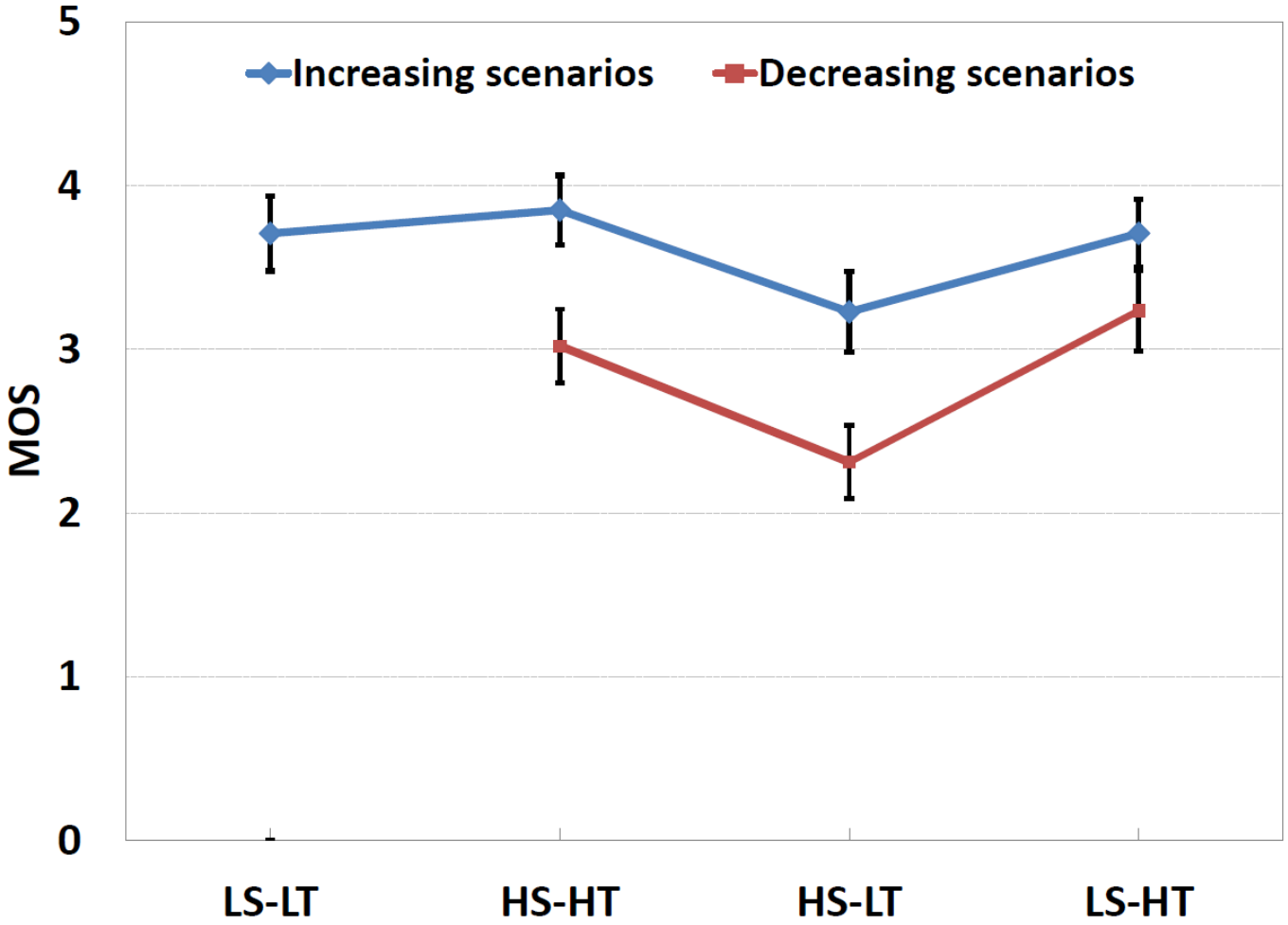
RESULTS – CONTENT CHARACTERISTICS



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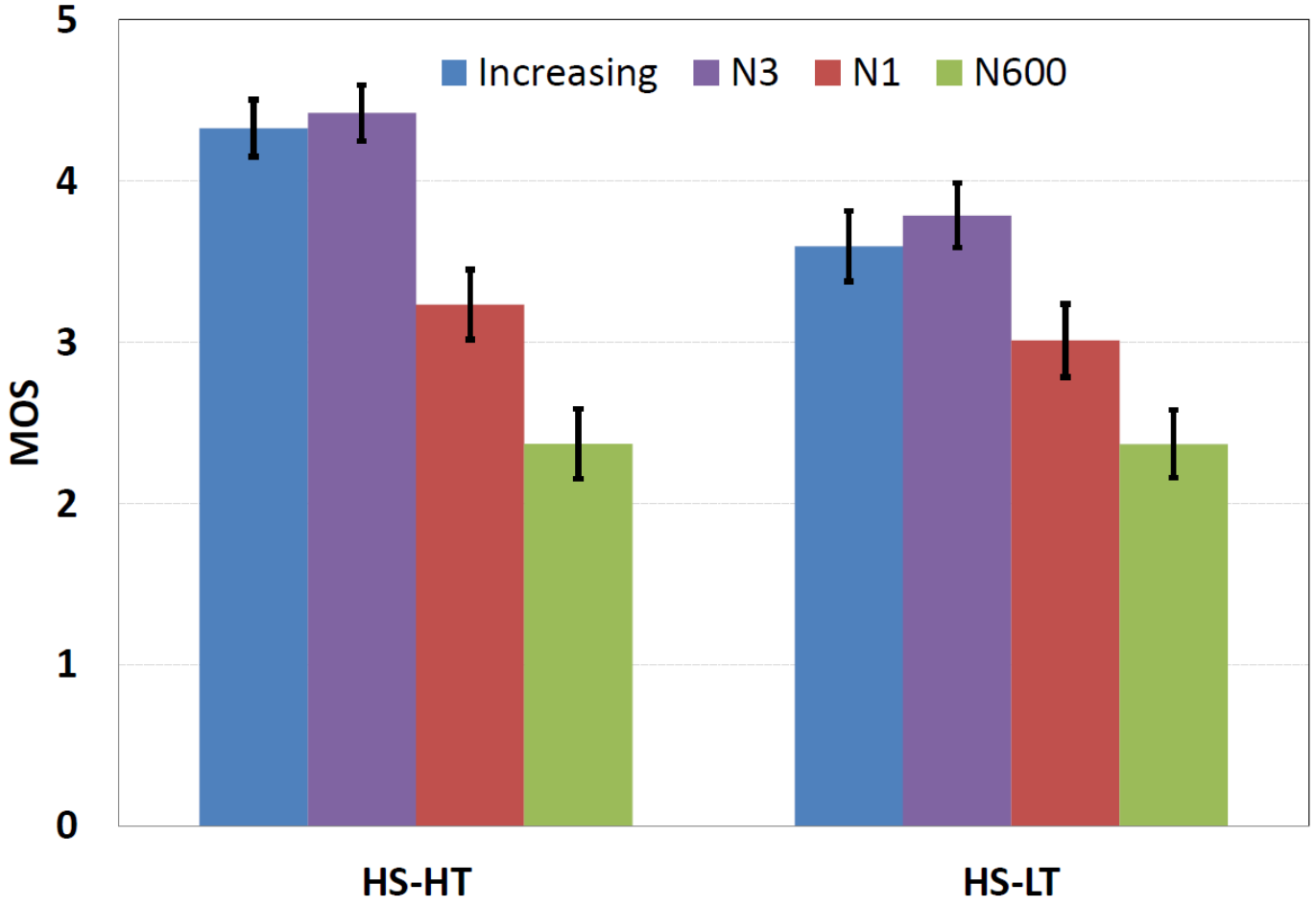
RESULTS – CONTENT CHARACTERISTICS



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CONCLUSIONS

- High Spatial – Low Temporal (HS-LT) has significantly lower quality than other contents

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DEMO – ”STREAMINGKOLLEN”

- Service for the user to check their connection for media consumption
- QoE estimation:
  - Pause intensity (PI) model
    - Measures the durations of pause periods due to an empty buffer in relation to play periods and maps this to user QoE according to a specific formula.
    - Pause Intensity: A No-Reference Quality Assessment Metric for Video Streaming in TCP Networks, Colin Bailey, Mirghiasaldin Seyedebrahimi, Xiao-Hong Peng School of Engineering & Applied Science Aston University Birmingham, UK, 2012 IEEE International Conference on Multimedia and Expo
  - Linear bitrate model
    - Measures changes in bitrates and maps this to user QoE according to a specific formula. The formula is based on the average and standard deviation of the bitrate during the video streaming.
    - Analytical method for objective scoring of HTTP Adaptive Streaming (HAS), Bill Krogfoss, Anshul Agrawal, and Lev Sofman, Broadband Multimedia Systems and Broadcasting (BMSB), 2012 IEEE International Symposium, 27-29 June 2012

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ACCEPTED PAPERS TO QOMEX 2014 IN SINGAPORE

- **CROWDSOURCING BASED SUBJECTIVE QUALITY ASSESSMENT OF ADAPTIVE VIDEO STREAMING**
  - **Muhammed Shahid, Jacob Søgaard, Jeevan Pokhrel, Kun Wang, Kjell Brunnström, Samira Tavakoli**
- **EFFECT OF CONTENT CHARACTERISTICS ON QUALITY OF EXPERIENCE OF ADAPTIVE STREAMING**
  - **Samira Tavakoli, Muhammed Shahid, Kjell Brunnström,**

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