Recent Developments in Visual Quality Monitoring by Key Performance Indicators

Emmanuel Wyckens, Silvio Borer, Mikołaj Leszczuk, Lucjan Janowski

Presentation Structure

- Introduction to Monitoring of Audio Visual Quality by Key Indicators (MOAVI)
- Origin of artifacts
- Video artifacts and related Key Performance Indicators (KPI) for automated quality checking
- Experimental setups for concept verification
- Results on KPI
- Deployment
  - NET-MOZAIC probe
  - NET-MOZAIC in the NET-xTVMS system
- Future work

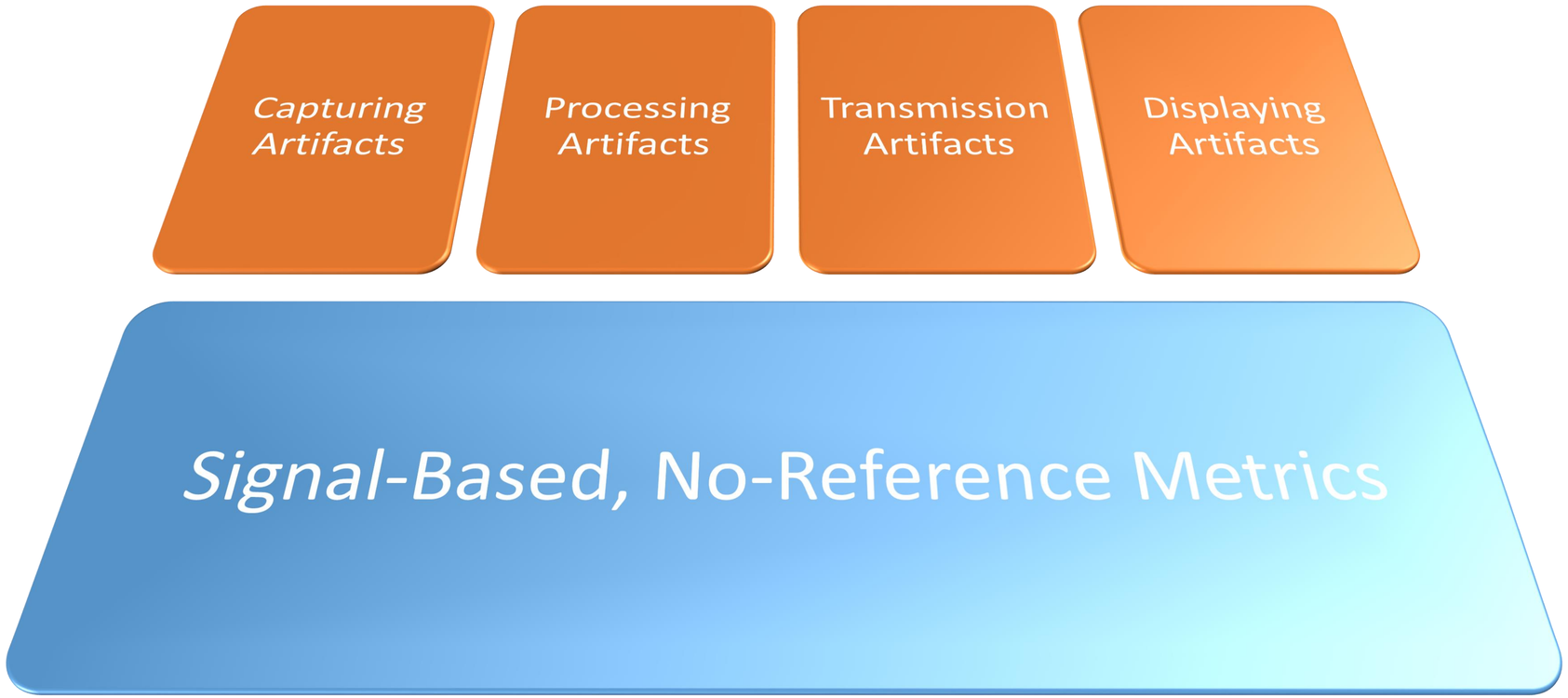
Introduction to MOAVI

Introduction to MOAVI

- Mission
  - *“To collaboratively develop No-Reference models for monitoring individual audio-visual service quality artifacts”*
- Goals
  - To develop set of key indicators describing service quality in general and by removing implementation constraint
  - To select subsets for each potential application
  - To concentrate on models based on key indicators contrary to models predicting overall visual quality

Origin of Artifacts

Origin of Artifacts



Video Artifacts and Related KPI for Automated Quality Checking

Video Artifacts and Related KPI for Automated Quality Checking

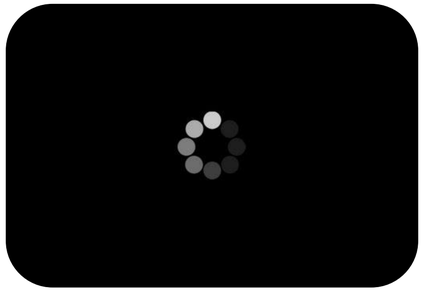
Blur

Exposure Time Distortions

Noise

Block Loss

Blockiness



Freezing

Slicing

Experimental Setups for Concept Verification

Mapping between KPI and Experimental Setups

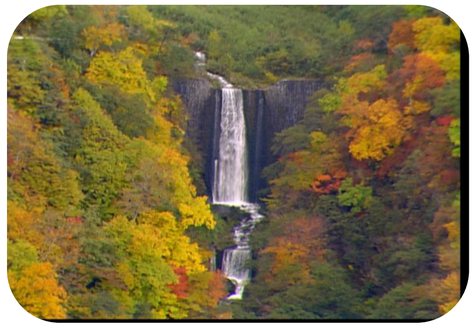
KPI	Experimental Setup
Blur	VARIUM 2013
Exposure Time Distortions	INDECT 2011
Noise	CONTENT 2009
Block Loss	VQEG HDTV 2010
Blockiness	VARIUM 2013
Freezing	VQEG HDTV 2010
Slicing	VQEG HDTV 2010

- Scores:
  - VARIUM 2013 – binary
  - Others – Absolute Category Rating (ACR) Mean Opinion Scores (MOS)
- Degradation Category Rating (DCR):
  1. **Degradation is very annoying**
  2. **Degradation is annoying**
  3. **Degradation is slightly annoying**
  4. **Degradation is perceptible but not annoying**
  5. **Degradation in imperceptible**
- ACR≈DCR?

Experimental Setups for Concept Verification

- CONTENT 2009:
  - 720×486@30
  - 100 subjects
- INDECT 2011:
  - 720×486@30
  - 24 subjects

Betes



Autumn

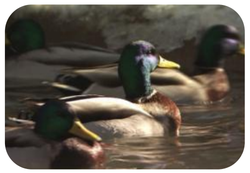
Football

Susie

Experimental Setups for Concept Verification

- VQEG HDTV 2010:
  - 1920×1080@25
  - 24 subjects

VQEG HD 4, SRC 1



VQEG HD 4, SRC 2

VQEG HD 4, SRC 3

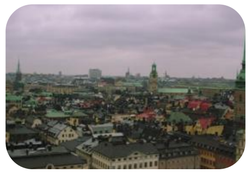
VQEG HD 4, SRC 4

VQEG HD 4, SRC 5

VQEG HD 4, SRC 6

VQEG HD 4, SRC 7

VQEG HD 4, SRC 8



VQEG HD 4, SRC 9

Common Set SRC 11

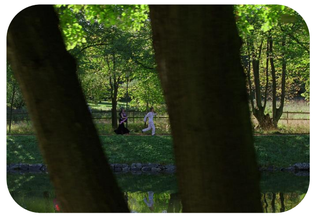
Common Set SRC 12

Common Set SRC 13

Common Set SRC 14

Experimental Setups for Concept Verification

- VARIUM 2013
  - 1280×720@50
  - 15 subjects



Joy Park

Into Trees

Crowd Run

Romeo & Juliet

Cactus

Basketball

Barbecue

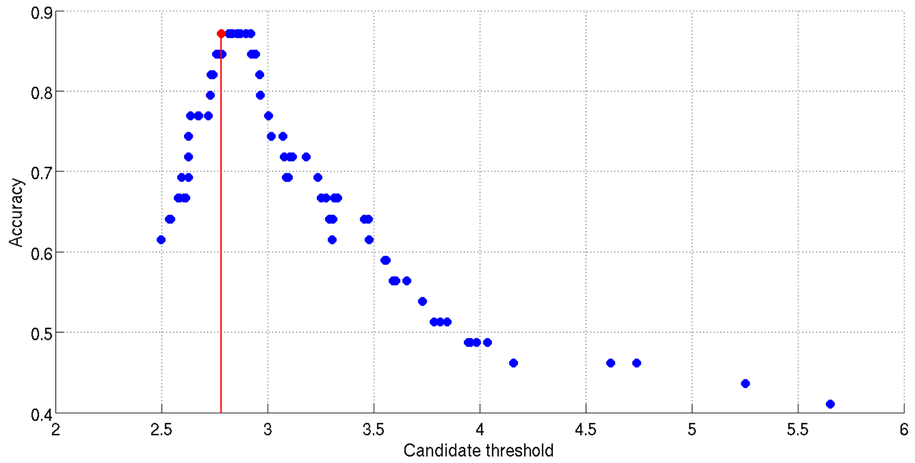
Results on KPI

Setting Metrics Threshold Value (Training Set)

1. For all video sequences from the appropriate subjective experiment the values of the metric is calculated.
2. We assume each successive value of metric as candidate thresholds th_{TEMP}. For values less then th_{TEMP} we set the KPI to 0 and to 1 for same or above.
3. For each th_{TEMP} we calculate the accuracy rate of resulting assignments. It is the fraction of KPI, which match with indications given by humans from the training set.

$$accuracy(th_{TEMP}) = \frac{\#\ matching\ results}{\#\ results}$$

4. We set the threshold of metric to the candidate th_{TEMP} with the best (maximum) accuracy. In the case of several th_{TEMP} values with the same accuracy we select the least value.



KPI Verification (Verification Set)

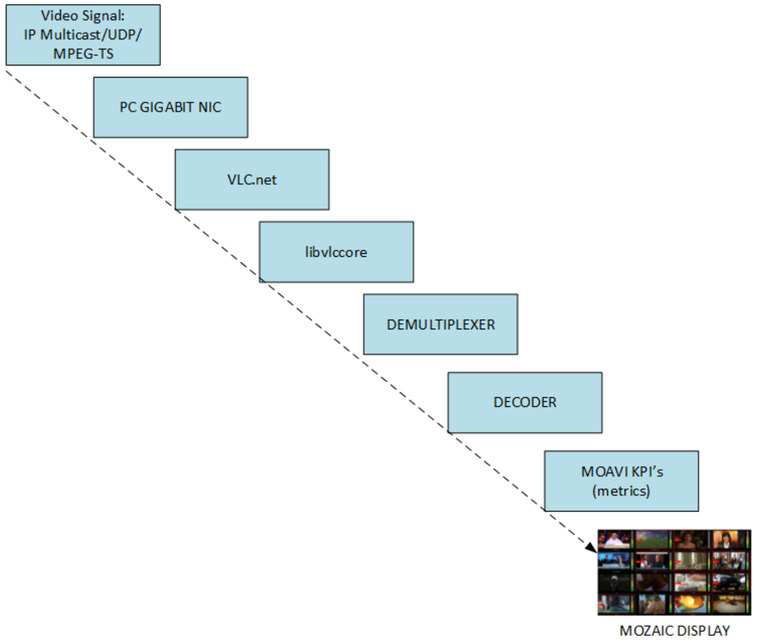
Metric	Probability of distortion detection	Value of threshold
Blur	0.86	2.78
Exposure Time Distortions	0.81	78 and 178
Noise	0.85	3.70
Block loss	0.84	5.3
Blockiness	0.94	0.85
Freezing	0.80	0
Slicing	0.85	7

Deployment

NET-MOZAIC Probe

Functional Diagram

- Satellite Video Encoders
- DVB-C cable TV
- DVB-CS Satellite TV
- DVB-T Off-The-Air TV broadcast
- VOD Servers



Key Features

- Simultaneous full motion preview and image analysis of up to 16 SD and/or HD channels
- Round-robin for up to hundreds of IPTV channels
- Integrated with Net-xTVMS system for centralized control/access or stand alone operation
- Supports MPEG-2 and H.264/AVC
- Supports audio codecs AC-3, MPEG-1 Level 2, MPEG-2 AAC, MPEG-4 AAC
- Supports UDP or UDP/RTP encapsulation
- All metrics have user defined alarm thresholds
- Long term storage of metrics
- Optional HDMI/IP encoding of a 16 channel group for advertising

MOAVI KPI (Metrics) Implemented in the NET-MOZAIC

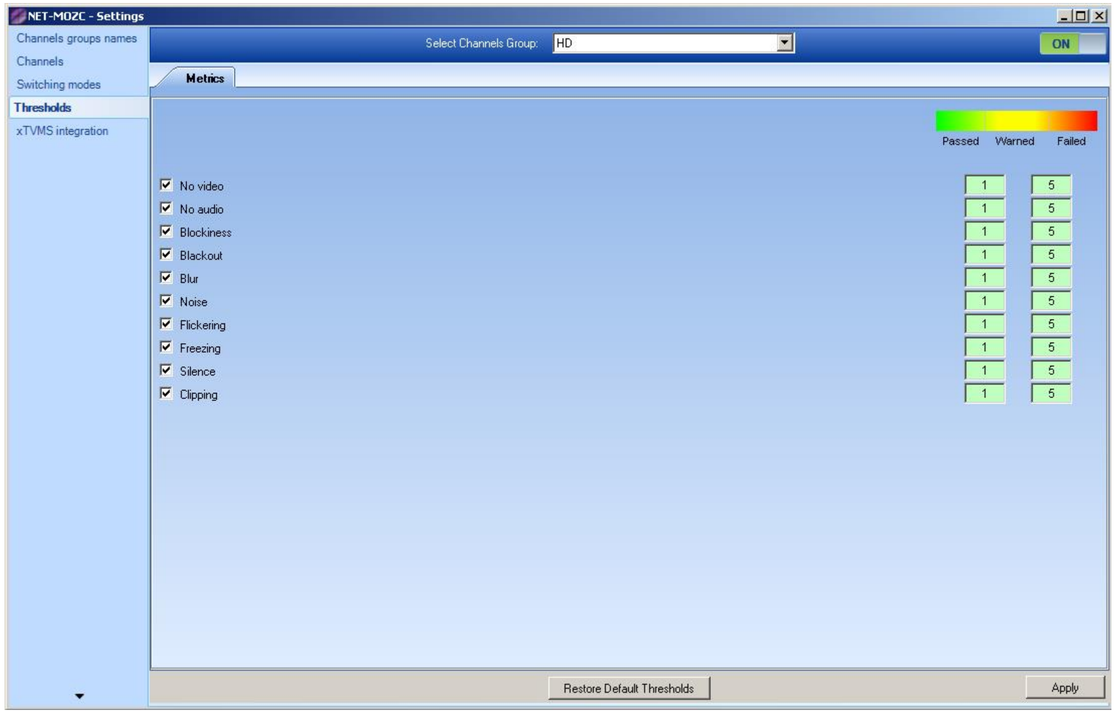
MOAVI Metrics

- Blur
- Exposure Time Distortions (brightness problem)
- Noise (within video picture)
- Block loss
- Blockiness
- Freezing (frozen picture)

Non-MOAVI Metrics

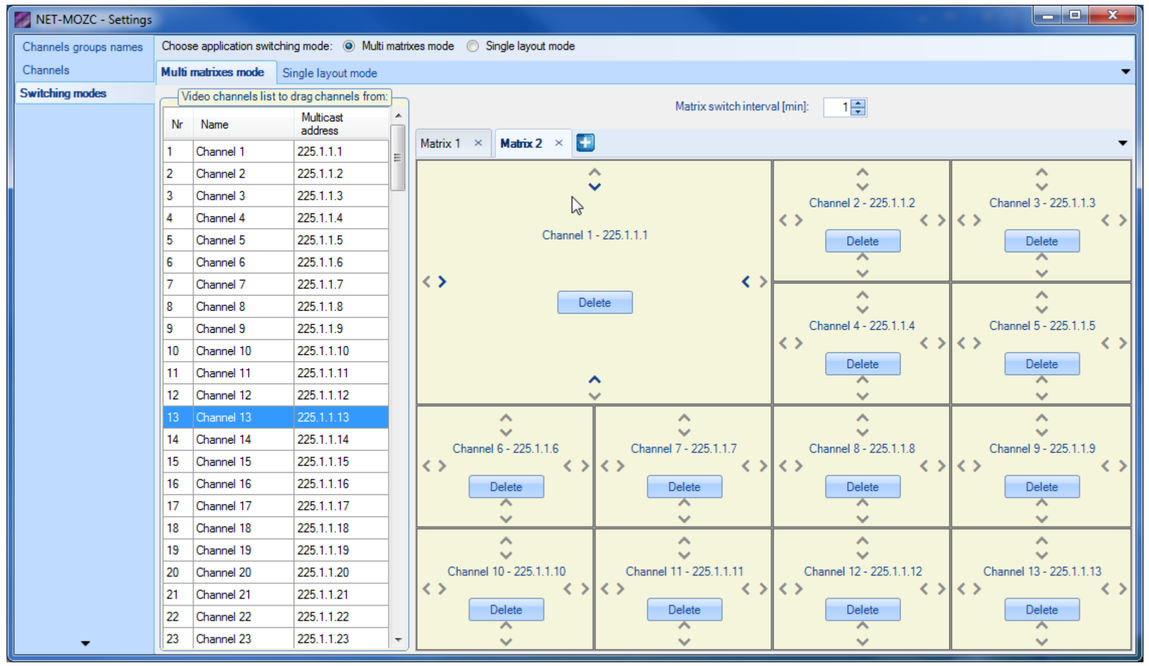
- Black screen
- Contrast problem
- Flickering
- Audio silence detection
- Audio clipping detection
- No Audio
- No Video

Set Up Menu


NET-M02C - Settings
Channels groups names
Channels
Switching modes
Thresholds
xTVMS integration
Select Channels Group:
HD
ON
Metrics
Passed
Warned
Failed
No video
No audio
Blockiness
Blackout
Blur
Noise
Flickering
Freezing
Silence
Clipping
1
5
Restore Default Thresholds
Apply

NET-MOZAIC Picture

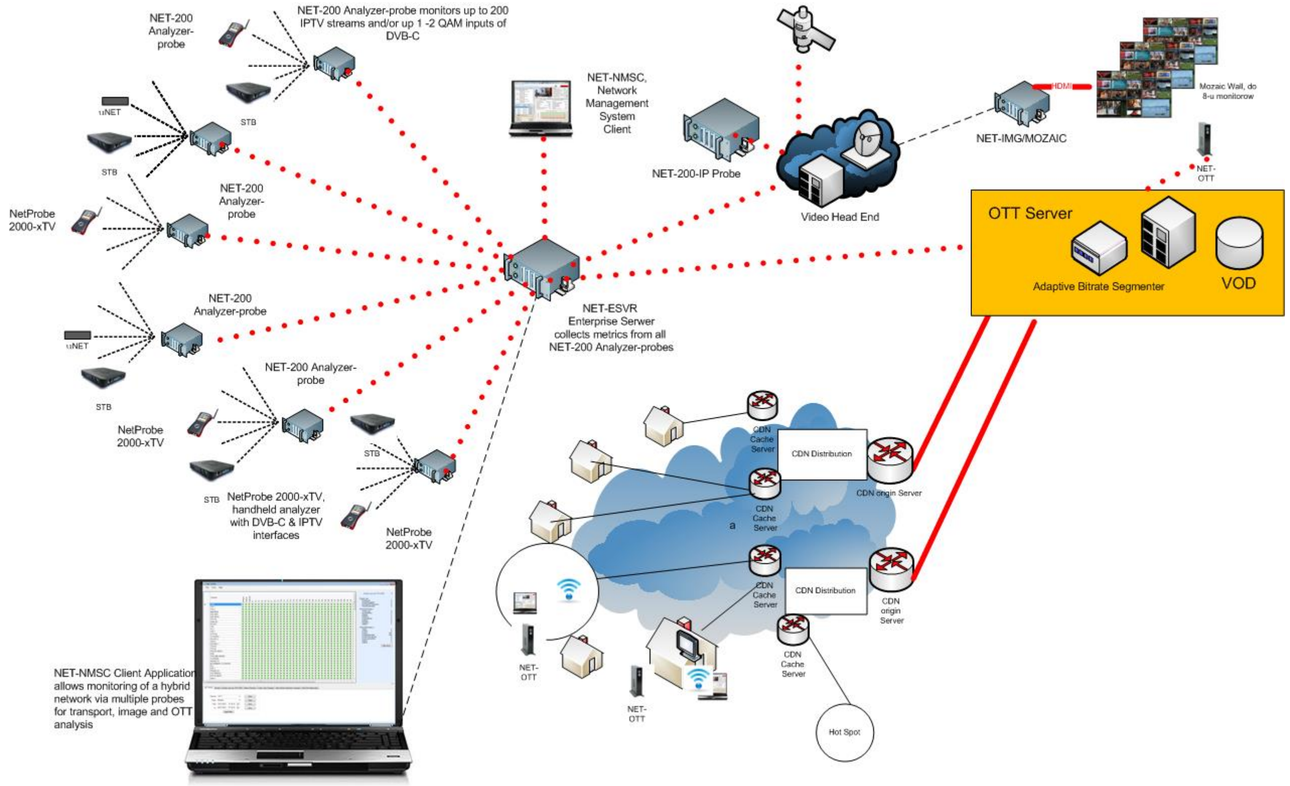
NET-MOZAIC Layout Settings



Deployment

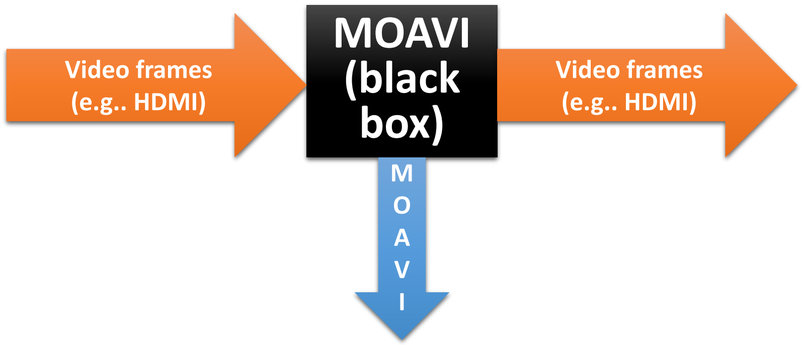
NET-MOZAIC in the NET-xTVMS System

NET-MOZAIC in the NET-xTVMS System



Future Work

Future Work



- To provide more tools and evaluation methods
- To deploy distributed probes for measuring quality in real-time
- To eventually target proposals for ITU Recommendations (P.930?)