The need to re-define QoE and its evaluation techniques within the context of the 5G network

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Agenda

• How is the dawn of 5G redefining QoE?
• What do test tool vendors need to adapt in QoE evaluation for 5G deployments?
• How is Infovista rethinking 5G QoE assessment?
• Key Takeaways?
How is the dawn of 5G redefining multimedia QoE?
The user perspective....

3G/4G (voice centric)

LTE-A/Pro (data centric)

5G (user centric)

eMBB

mMTC

URLLC

NEW CONVERSATIONAL (QoE)

NEW TV (QoE)

NEW Context Aware QoE

TRADITIONAL QoE

Gaming

Holo

VR

AR

Machine QoE

NETFLIX

prime video

NEW TV (QoE)

NEW CONVERSATIONAL (QoE)

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The 5G technical disruptions impact...

5G Key Features
- mmWave
- mMIMO 3D Beamforming
- Device centric
- Self-contained Transmission
- Flexible Numerology & Slot Structure
- Network Slicing

5G Target Use Cases
- FWA
- eMBB
- URLLC
- Massive IoT

Features:
- Coverage, Capacity, Throughput
- Latency
- Spectral efficiency
- Capacity, Latency & Throughput

Flexibility: no one size fits all dynamic management of QoS/QoE per slice and within the slice (EPC-QCI allocation)
The telcos concerns’ redefinition

……………………considering only multimedia QoE supported by eMBB network slice

- Standardized (VoLTE) and non-standardized (OTT) Clients/jitter buffers error concealment (ML based)
- Frequency responses

5G
- Sophisticated human perception and demand
- Complex new services (e.g. VR/AR, 3D video) with new impact on users
- Context aware protocols and delivery (AI/ML based)
- Context aware QoE (AI/ML based)

• Original content quality
• Resolutions
• Transcoding / resolution switches
• Encryption

Network Testing Tool Vendors
What do test tool vendors need to change in QoE evaluation for 5G deployments?
The way we look at traditional QoE models

...at least for video service and much more at 5G dawn

Select the proper approach for reliable QoE centric solution based on video OTT and evaluation/test type

CRITERIA

- Variety of OTTs, contents
- Delivery protocol; dynamically changing (RTP, UDP, TCP, QUIC)
- Encryption
- Video codecs/containers/clients
- Video resolution (HD, 4K, 3D)
- Variety of devices/displays
- Test scenario and tools (accurate QoE, quality trend detection, monitoring and troubleshooting)
- Ways in which the user consumes the service
- New services: Gaming, AR/VR
- New performance requirements: real time rather than streaming

“No one size fits all” and a single MOS score cannot provide a holistic QoE view of 4G/5G multimedia
The way we close the gap between traditional QoE models and QoE field measurements ....

The simplest scenario: voice demo

- Test sample / talkers
- Frequency (filters) tuning
- Level calibration
- Disturbances
- App

Analog

Digital

Stand

Non-stand

Automation of traditional QoE models implementation at the brink of sustainability with 5G devices
The way we understand increased and continuously changing inter-dependencies

........................................and much more so at 5G dawn

The simplest expected scenario: voice demo

Untangling the complex relationship between jitter, packet loss and MOS

Jitter (ms) (z axis) during one 5.5s long RTP sequence (x axis) during a call duration (y-axis)

Traditional QoE models hardly expected to cope with these kind of inter-dependencies
The way we must look at multimedia QoE defined by new emerging 5G VR/AR services ….

Human
- Vision & Hearing
- Immersion
- Sickness
- Interaction, Touch….

System
- Content (real/virtual; e.g. video/audio, stitching, 3D special effects, composition)
- Media&coding (e.g. bit/frame rate, resol)
- Network&transmission (e.g. BWD, dly, loss)
- Hardware (e.g. field view, depth range, refresh rate, display resolution, enc/dec. performance)
- Interaction (e.g. speech recognition)

Context
- Physical
- Temporal
- Social
- Task

No single traditional QoE model for all impacting factors is expected
Traditional MOS ground truth could be challenged
The way we must look at 5G QoS/QoE facts …. 

- 5G (R)Evolution expected to enable **context aware QoE delivery** and therefore new user perceptual/cognitive demands based on **significantly** increased complexity of QoE-network/device/service inter-dependencies, which is expected to be less and less possible to humanly control and manage at optimal costs
  - ML / AI based QoS/QoE delivery and management
  - New services such as VR/AR, gaming
  - Machines as users (with NB-IoT/LTE-M, mMTC, URLLC)
- Traditional MOS ground truth (lab subjective tests) could become costly prohibitive and likely not suitable for emerging 5G services such as VR/AR requiring other techniques / source as MOS ground truth

**Vertical application centric QoE definition**
**Easy adaptive ML based QoS/QoE methodology**
**More real time & Predictive**
How is Infovista rethinking 5G QoE assessment?
Rethinking QoE modelling and testing with ML

User centric
- Device characteristics
- Media signal encoding quality and distortions
- User conditions/intercations
- "context aware" concept with 5G

Network centric
- RAN parameters
- IP transport parameters
- "context aware" QoS/QoE delivery with 5G

Application centric
- Generic OTT client / jitter buffer to capture user impact for multitude of apps and simulatenous testing
- Already "context aware" delivered
- VR/AR strategies to be defined
Rethinking QoS/QoE assessment: from real time to prediction

Analytics orchestrator

Real Time Data Streaming

Data Validation

Symptom & RCA detection, s-t-ne localization

Learn

Probes Data

Predicted coverage

Planning Data

Augmented measurements:
- Predicted QoS/QoE (e.g. latency, throughput, voice/video QoE)
- Bandwidth/traffic forecast
InfoVista’s technology support and approach for QoS/QoE over 5G NR

Pre-rollout
Spectrum clearing, prediction model tuning, interference id & location, coverage gain vs. 4G

Rollout: Verification/Acceptance
5G Site Verification with visibility into issues that need addressing for acceptance; device -5G site interaction/interoperability

Deployment
4G – NR interoperability for maximized capacity and improved QoE through efficient (NSA) optimization & troubleshooting: ensure the network works as planned; identify and diagnose/solve gaps

Planning
Maximize 5G spectrum assets with QoE centric approach
Automated precision drive test- based model tuning using ("drive where it matters")

QoS/QoE over 5G NR

O&M, 5G BenchMarking
QoS / QoE testing and prediction
Augmented QoS/ QoE: measure, diagnose, learn, predict
Easy adaptive network centric ML based QoE modelling

Coverage in 30s
Limited QoS/QoE in 10s
Poor coverage in 30s
No service in 10s
Bad coverage in 20s
Bad QoS/QoE
Poor coverage in 30s
QoS/QoE impact expected

Found legacy network

Improve prediction of augmented QoS/QoE measurements
….and working within ITU-T context and contributing to 5G QoE activities...

*Study Group 12: Performance, QoS, QoE*
- Machine learning based QoE (e.g. P.VSQMTF)
  - InfoVista VoLTE/Vo5G voice testing
  - sQLEAR

*Study Group 12: Performance, QoS, QoE*
- Intelligent network diagnosis (e.g. E.FINAD)
  - InfoVista Analytics

*Study Group 13: Future Networks – IMT 2020 Focus Group*
- ML for Future Networks including 5G (ML5G)
  - InfoVista Augmented Measurements

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Key Take-aways?
Take aways

Voice and video-audio service QoE Models

Context aware QoE (5G expected)

New services QoE (e.g. VR/AR, machine QoE)

Adapt/improve Data validity, non-overfitting

4G/LTE-Pro

QoE modeling and evaluation & Predictive QoS/QoE FOR

5G adaptive QoS/QoE centric service delivery and management

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