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 Take-aways?

How is the dawn of 5G redefining multimedia QoE?

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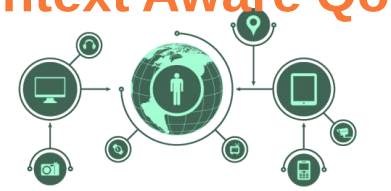
The user perspective….

NEW
Context Aware QoE



eMBB
mMTC
URLLC
5G
(user centric)

LTE-A/Pro
(data centric)

Pay

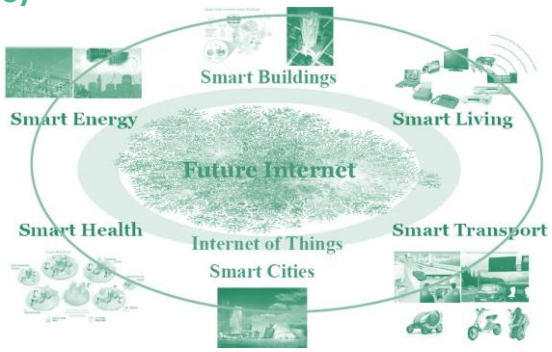
CNN Alexa

VR

Holo

AR

Gaming



Machine QoE

3G/4G
(voice centric)

TRADITIONAL
QoE

Instagram

facebook

twitter

prime video

NETFLIX

NEW TV (QoE)

NEW CONVERSATIONAL (QoE)

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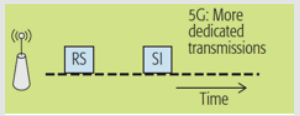
The 5G technical disruptions impact….

Very relevant

Applicable

5G Key Features

5G Target Use Cases

5G Key Features	mmWave	mMIMO 3D Beamforming	Device centric	Self-contained Transmission	Flexible Numerology & Slot Structure	Network Slicing
FWA						
eMBB	●	●	●	●	●	●
URLLC	●	●	●	●	●	●
Massive IoT	●	●	●	●	●	●

Spectral efficiency

Coverage, Capacity, Throughput

Latency

Capacity, Latency & Throughput

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

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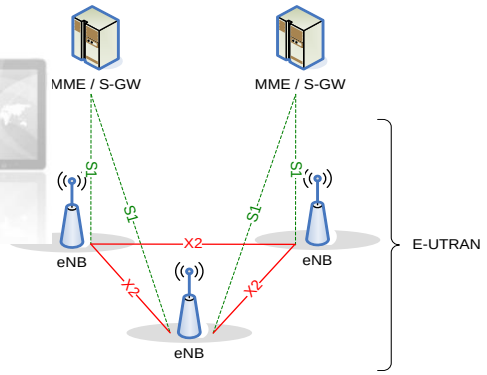
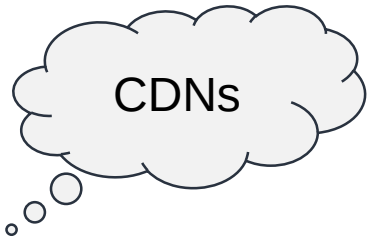
The telcos concerns' redefinition

……considering only multimedia QoE supported by eMBB network slice

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



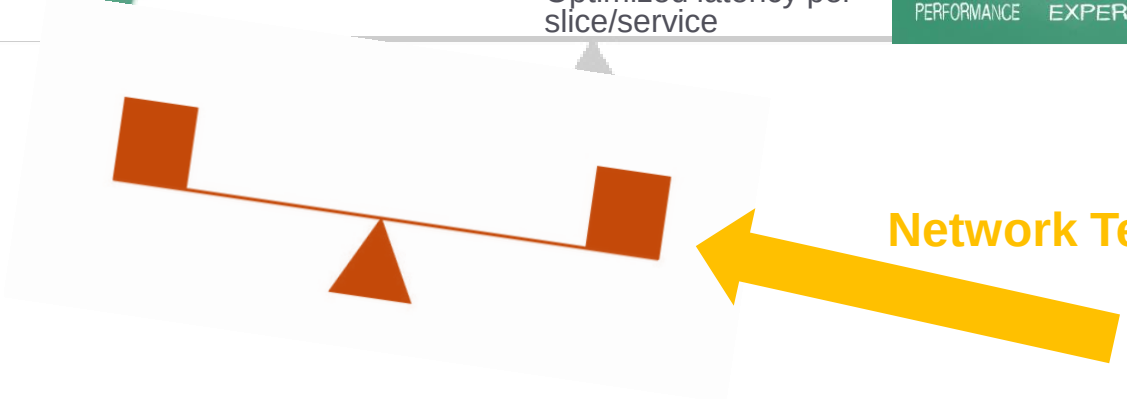


- Original content quality
- Resolutions
- Transcoding / resolution switches
- Encryption

5G

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

- Densification/coverage
- Capacity
- Optimized bandwidth/throughput per service
- Optimized latency per slice/service



Network Testing Tool Vendors

What do test tool vendors need to change in QoE evaluation for 5G deployments ?

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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

Complexity,
Required Input Metadata

HTTPS/TCP
(e.g. Netflix,
Amazon)

HTTPS/TCP
(e.g. YouTube)

QUIC/UDP
(e.g. YouTube)

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

Content variety
Encryption depth

Accuracy

"No one size fits all" and a single MOS score cannot provide a holistic QoE view of 4G/5G multimedia

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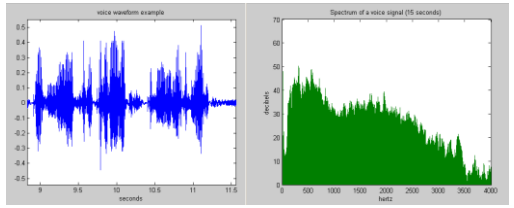
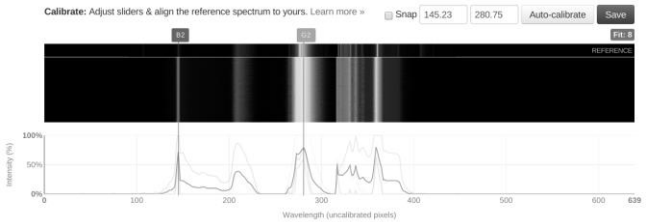
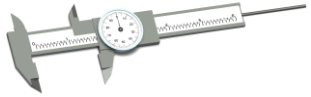
The way we close the gap between traditional QoE models and QoE field measurements ....

The simplest scenario: voice demo







OTT

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

Analog

Digital

Stand

Non-Stand

Implementation

Automation of traditional QoE models implementation at the brink of sustainability with 5G devices

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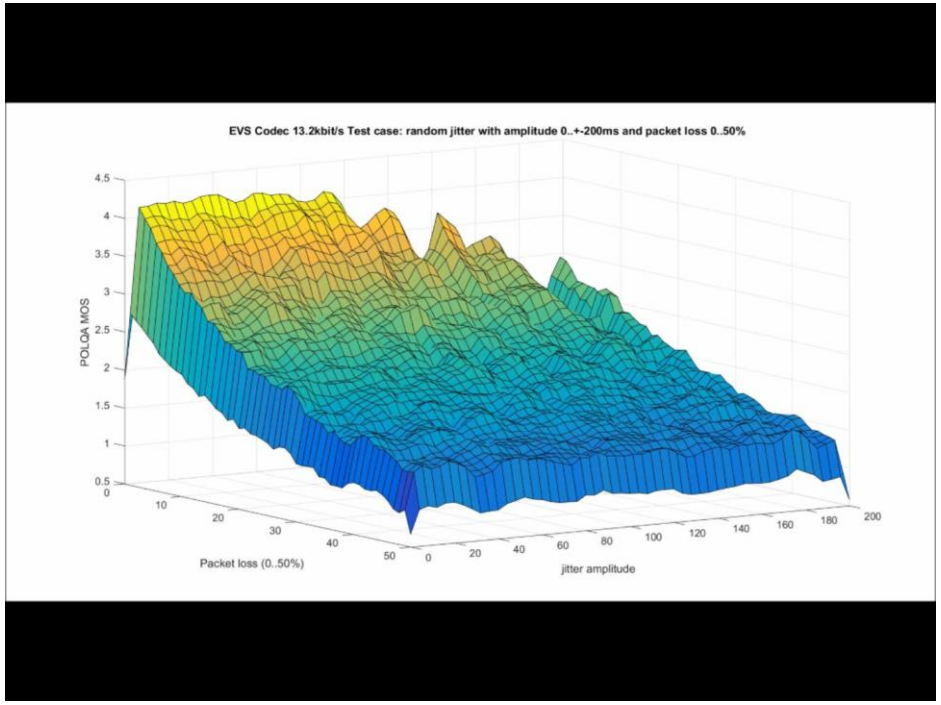
The way we understand increased and continuously changing inter - dependencies

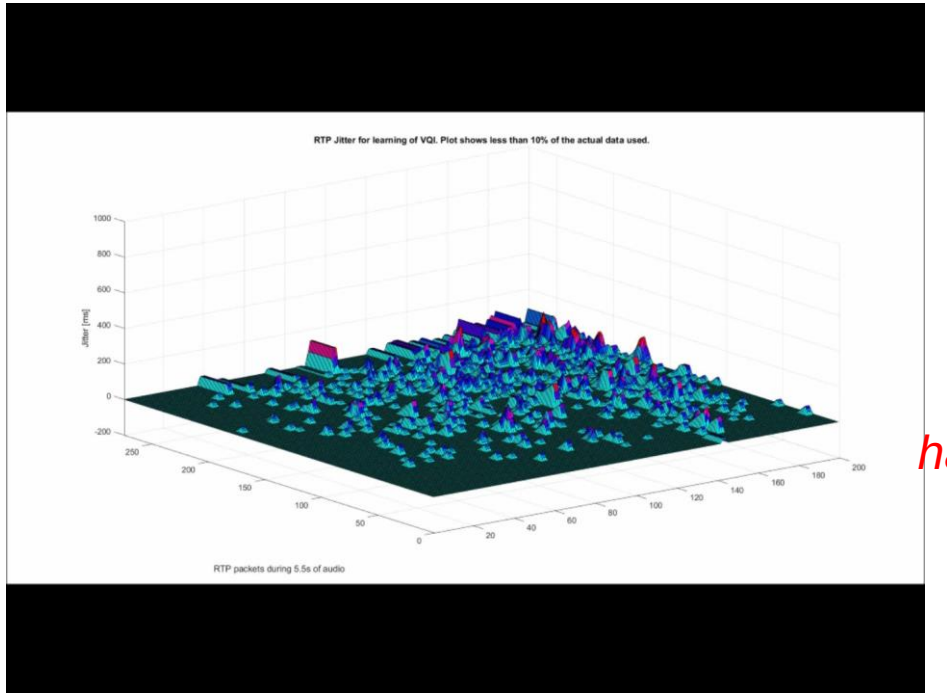
…….and much more so at 5G dawn

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 ….

VR

Live, On Demand, Social, Shopping
Gaming

AR

Face, Space

Human

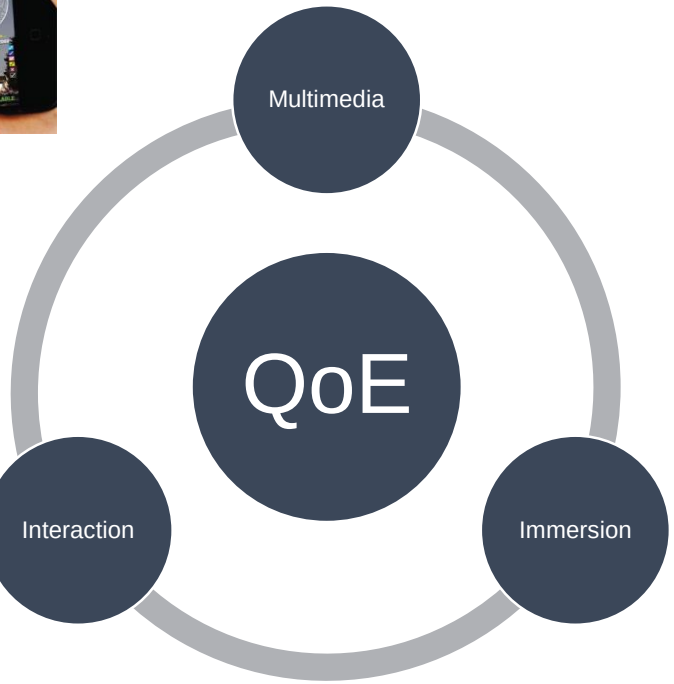
- Vision & Hearing
- Immersion
- Sickness
- Interaction, Touch….

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

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The way we must look at 5G QoS/QoE facts ….

- 5G (**R)E**volution 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?

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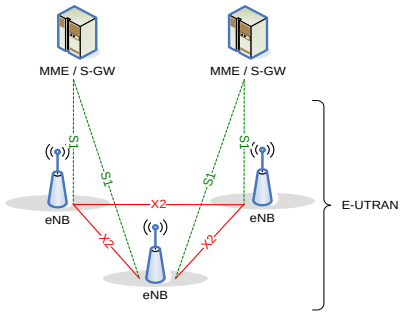
Rethinking QoE modelling and testing with ML

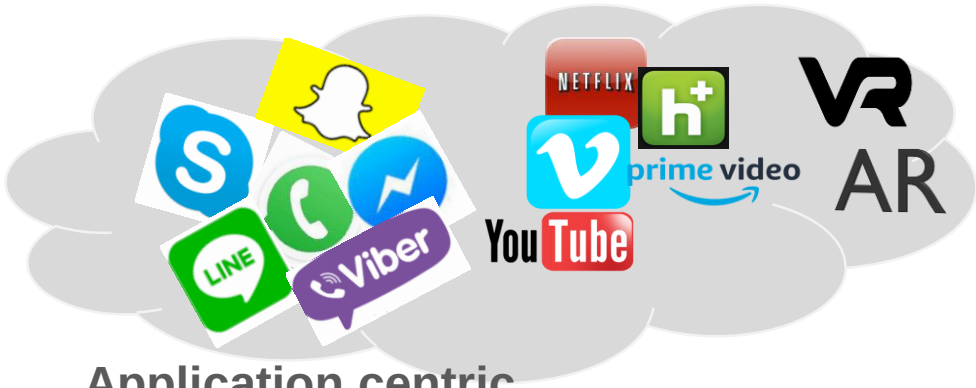
User centric

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



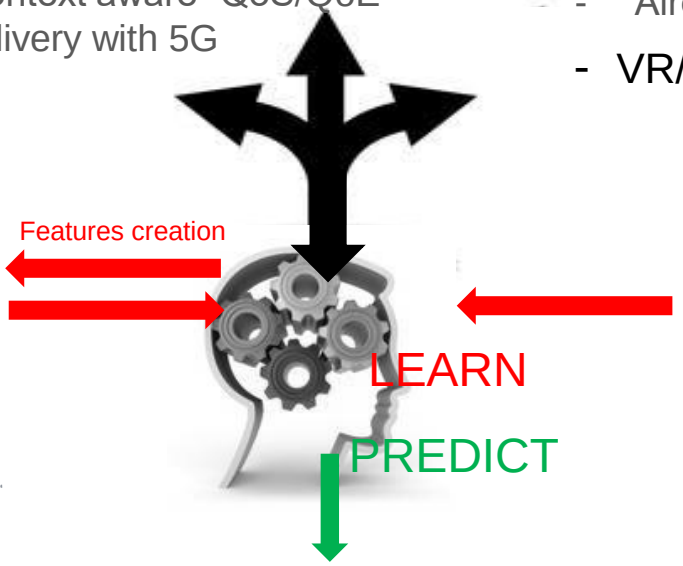
Network centric

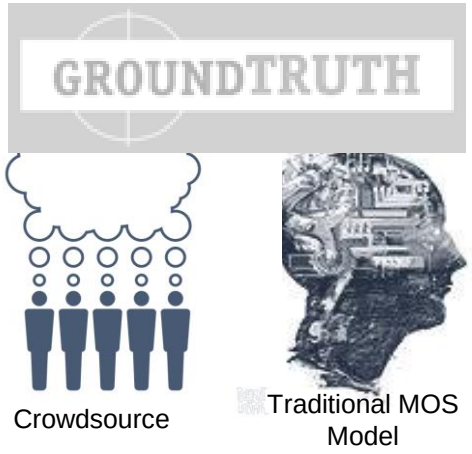
- RAN parameters
- IP transport parameters
- “context aware” QoS/QoE delivery with 5G



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





Other such as min. req. profiles for a given AR/VR performance

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Rethinking QoS/QoE assessment: from real time to prediction

Analytics orchestrator

Probes Data

Real Time
Data Streaming

Data Validation

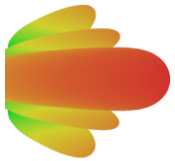
Symptom & RCA
detection, s-t-ne
localization

Learn

Predict

Predicted coverage

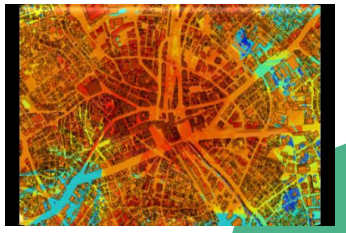
Planning Data



Predicted Throughput

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



Planning

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

QoS/QoEo5GNR

Pre-rollout

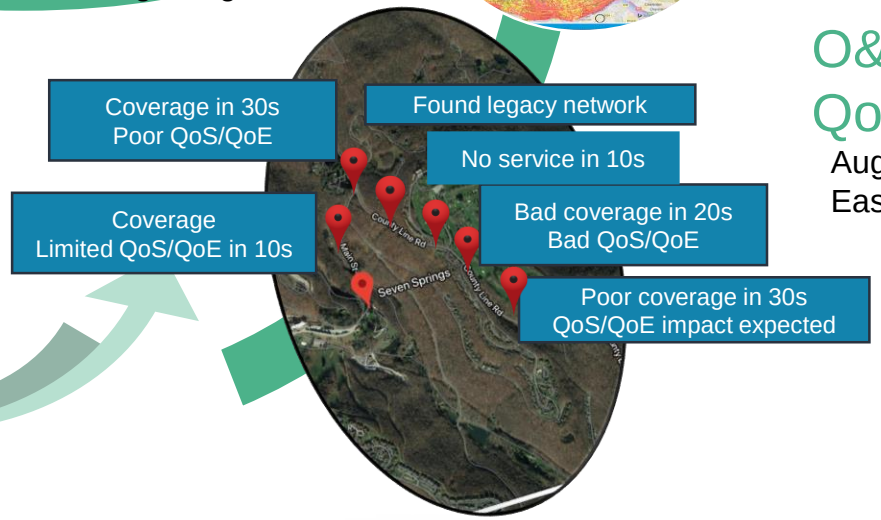
Spectrum clearing, prediction model tuning, interference id & location, coverage gain vs. 4G

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



O&M, 5G BenchMarking
QoS / QoE testing and prediction

Augmented QoS/ QoE: measure, diagnose, learn, predict
Easy adaptive network centric ML based QoE modelling

Improve prediction of augmented QoS/QoE measurements

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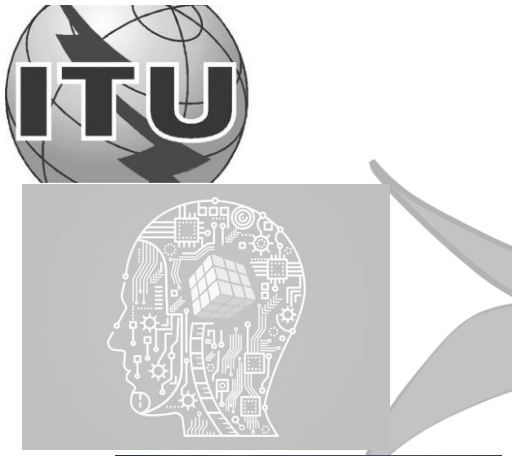
….and working within ITU-T context and contributing to 5G QoE activities...



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 ?

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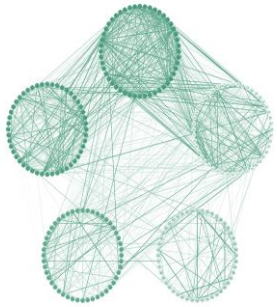
Take aways

Context aware QoE (5G expected)

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

Network Complexity

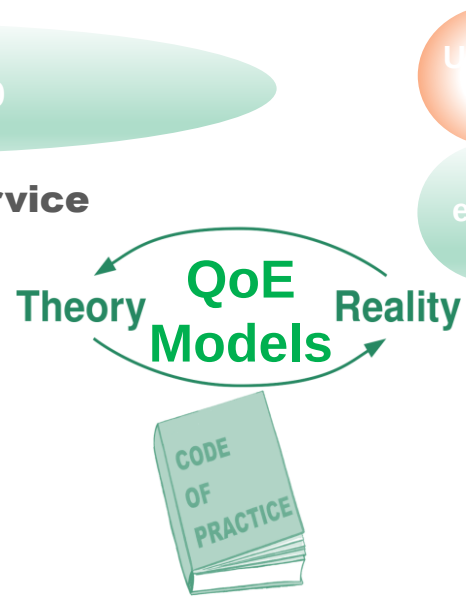


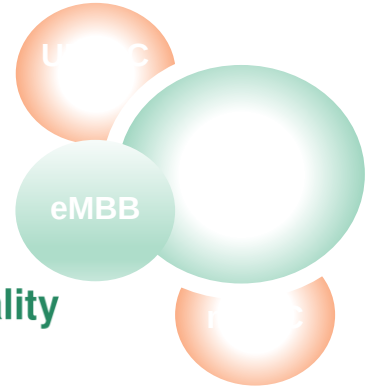
User/device/network/CDN Interdependencies

Adapt/improve Data validity, non-overfitting

4G/LTE-Pro

Voice and video-audio service QoE Models





QoE modeling and evaluation & Predictive QoS/QoE FOR 5G adaptive QoS/QoE centric service delivery and management

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