TEMS UX

Generic User Experience Testing Approach for OTT voice, Video and Interactive Apps and Services

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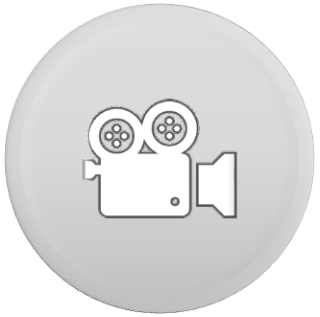
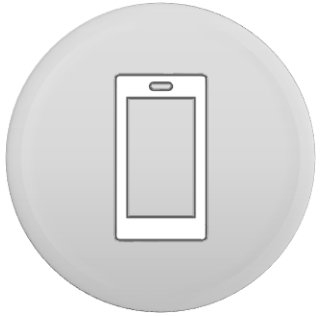
Agenda

A glance to TEMS solutions for OTT apps testing



Introduction of **VSQI** (Video Streaming Quality Index)



TWAMP for OTT interactivity scoring

Introduction of **sQlear** (Voice over IP Quality testing)

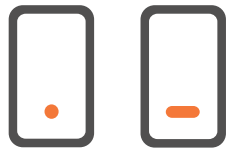
Why take a generic testing approach?

Challenges

Network statistics provide **very little insight** into a customer's QoE across apps and services

App and service **performance is critical** to overall satisfaction with the network

It is **impossible to test** the performance of **all the apps** and service available



Generic Testing Approach

Benefits

Practical and cost-effective approach which closely mimics real apps and services

Delivers **trustworthy results** which are highly correlated to real-world testing

Confidence the network will **deliver the expected user experience** across all apps

Understand user experience with TEMS™ UX testing

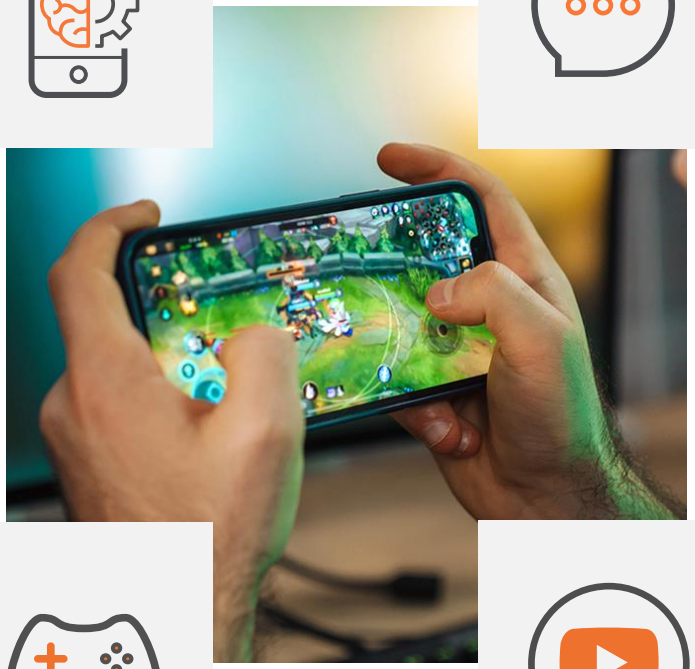
Accurately measure QoE for all native and OTT applications and services

sQLEAR

Voice quality testing for VoNR, VoLTE & OTT voice

Generic OTT voice testing

OTT voice quality testing with a generic client approach



Interactivity Scoring

User interactivity testing with generic OTT service/app traffic patterns

Generic OTT media testing

OTT application testing with a generic framework approach

Generic OTT voice testing

OTT voice quality testing using a generic client approach

Challenge

- Testing mobile OTT voice services/applications is important but practically impossible due to encryption, proprietary codecs, error concealment schemes etc.

Solution

- Infovista's generic OTT voice client accurately mimics the behavior of OTT voice clients (e.g. WhatsApp audio call)

Benefits

- The generic client provides the ability to test only one OTT application, one version and one set of fully accessible KPIs (free of encryption)
- The result is a reference of network performance for OTT voice applications

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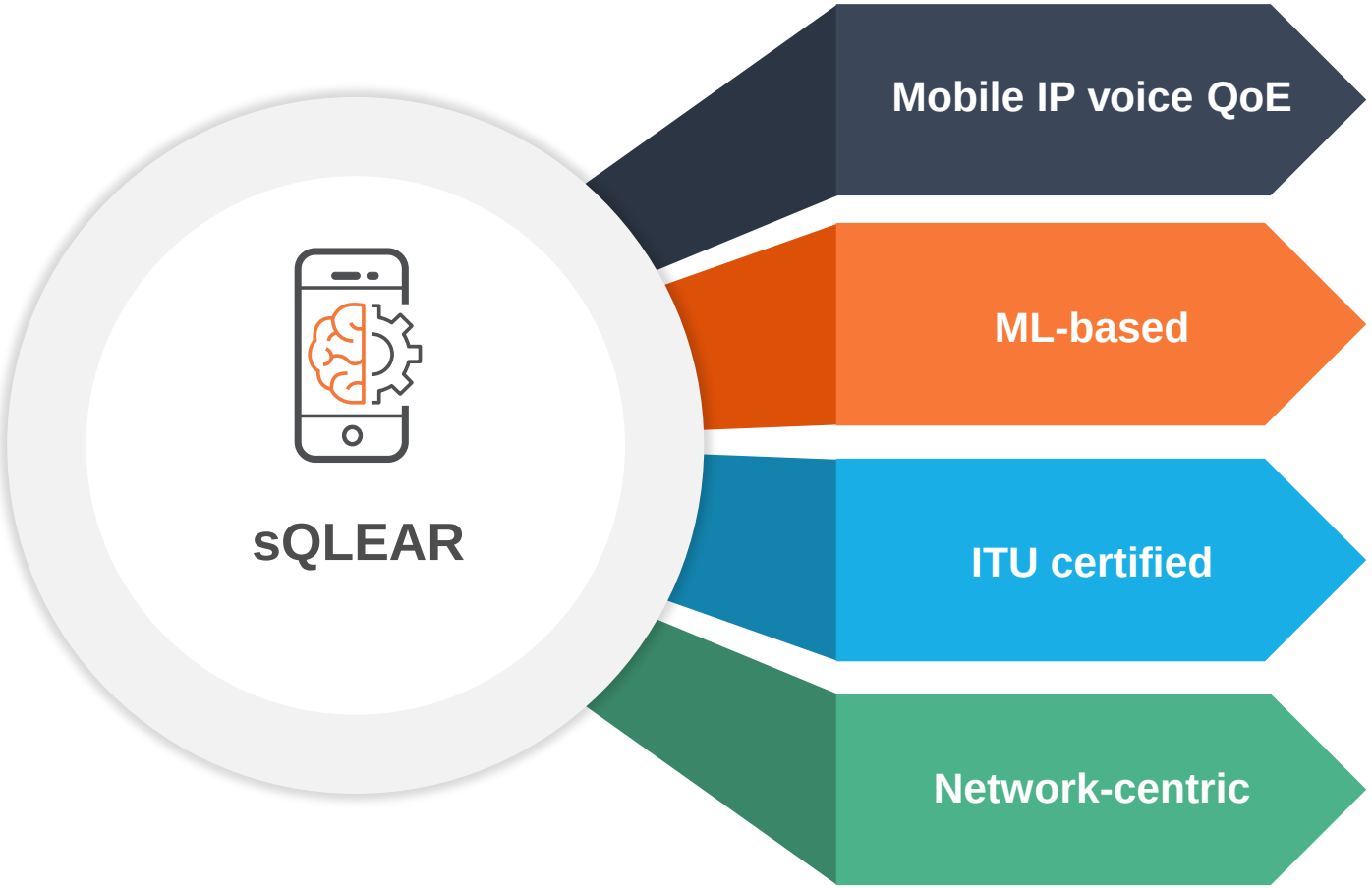
sQLEAR – speech Quality by machine LEARning

VoNR, VoLTE and OTT audio quality testing (MOS scoring)



MOS value AQM scoring of mobile all-IP voice services, including VoNR, VoLTE and OTT voice

Innovative ML-based algorithm utilizing standardized voice codec and client information

Certified as ITU-T P.565.1, sQLEAR is Infovista intellectual property

Device agnostic, real-time view of true voice quality, no need to test every individual device

Audio quality measurement (AQM)

Predict MOS (mean opinion score) values to estimate voice quality of service

TEMS products support **sQLEAR** and **PoLQA v3** to measure the audio quality of modern voice codecs (EVS, OPUS, and AAC) used for VoNR, VoLTE

Note: POLQA v2.4 is not suited for VoLTE, VoNR and OTT voice applications as it is sensitive to distortions above 14KHz, new codecs are minimum 24KHz

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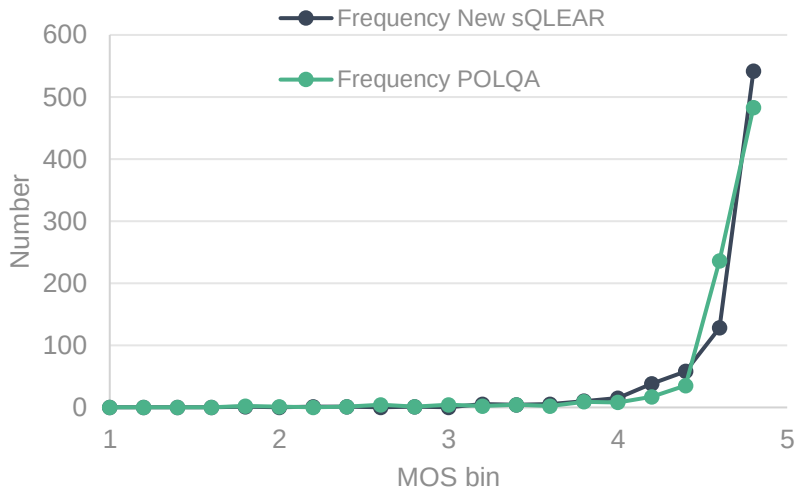
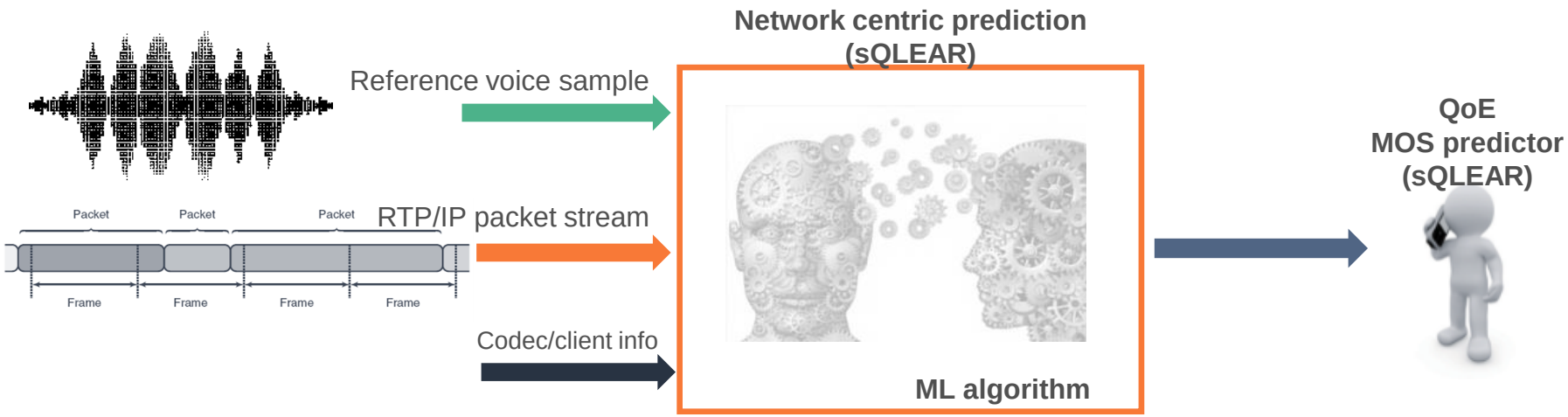
sQLEAR- Speech Quality by machine LEARning

sQLEAR is based on P.565 ITU P.VSQMTF- a Machine learning framework for network centric voice quality prediction

- Network centric solution, instead of device centric having needs for device specific Audio tuning
- Mobile To Mobile testing, possible to run tests using older phones and different models (A-part/ B-part)
- Works for VoLTE (EVS and AMR-WB), but will be extended with OTT support in H2 CY2020
- Tuned to match results from POLQA (97% correlation)
    - POLQA score can be different with sQLEAR, beacuse it includes the device specific audio parts.



How sQLEAR works



- Uniquely based on **machine learning** techniques
- **Hybrid** (intrusive parametric) QoE/MOS predictor
- **Device** (audio path) **independent**
- ITU-T P.565 based; **ITU-T accuracy**

- Network centric troubleshooting, monitoring, benchmarking of
  - UHD VoLTE,
  - UHD VoNR
  - OTT/WhatsApp

Generic OTT media testing

OTT media application testing using a generic framework approach

Challenge

- OTT apps are constantly changing and can differ between devices, countries and even networks – not feasible to test them all

Solution

- Native Python UI automation scripting for setting up the tests solves the changing application challenge
- Generic test methodology and KPIs across all OTT media applications, aligned with ETSI specifications

Benefits

- Generic framework approach allows operators to quickly test any OTT media application with consistency and confidence

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Testing challenges for OTT video streaming applications – reminder

Encryption

Continuously and dynamically changing

Various levels of complexity

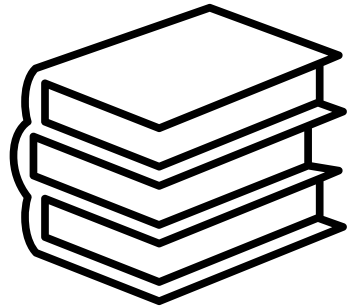
Today’s OTT market trend towards full encryption

Variety and diversity

Delivery protocol

Codecs/clients >> different performances

Multitude OTT apps



Multiple QoE metrics

Not a single ITU standard

None of the available ITU standards are directly implementable in testing tools

VSQI – Video Streaming Quality Index

Network-centric and OTT application agnostic video quality assessment

OTT video streaming apps

Parametric QoE / MOS values support any OTT video streaming apps up to 8K resolutions

QoE quantifying the network impact

- Device and OTT app agnostic with real-time view of "network true" OTT video streaming media quality,
- Normalization to most sensitive video content for measurement reliability

Based on real user QoE (ITU-T based)

Trained/validated alongside PEVQ-S. Infovista proprietary VSI solution is based on ITU-T P.120x.x series.

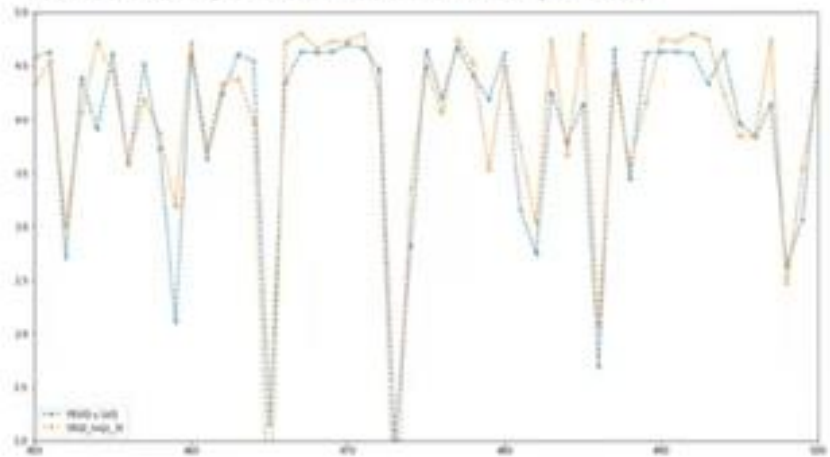
OTT Media: Video Streaming Quality Index

Video streaming quality Index **VSQI,** is a network-centric and APP agnostic quality score, using a parametric QoE model and existing streaming KPIs

- $VSQI_{Instant}$ is a quality score for troubleshooting, based on resolution, frame rate, and streaming state, and will be calculated every second after prebuffering.
- $VSQI_{Session}$ is a quality score for benchmarking that will be calculated once per session after 30 seconds of video playout. Inputs are prebuffering, rebuffering, and average $VSQI_{Instant}$.

VSQI (ITU P.120x.x series)	PEVQs (ITU J.343)
OTT app agnostic	YouTube only
TEMS & Connectable device	TEMS Device
Network centric	Device centric
Encryption independent	Encryption dependent
Network centric	Device centric
Drive testing granularity every 1 sec	Every 4 sec
IV intellectual property	3PP utility with cost

YouTube comparison PEVQs vs VSQI (lab test)



Interactivity scoring

TWAMP based interactivity testing solution

- Interactivity Score is specifically designed to **test latency-sensitive applications**, critical for 5G
- Generic traffic patterns emulate traffic behavior and its adaptability to network conditions in the same way as a real application would

Mobile eGaming

Remote meetings

Video Chat

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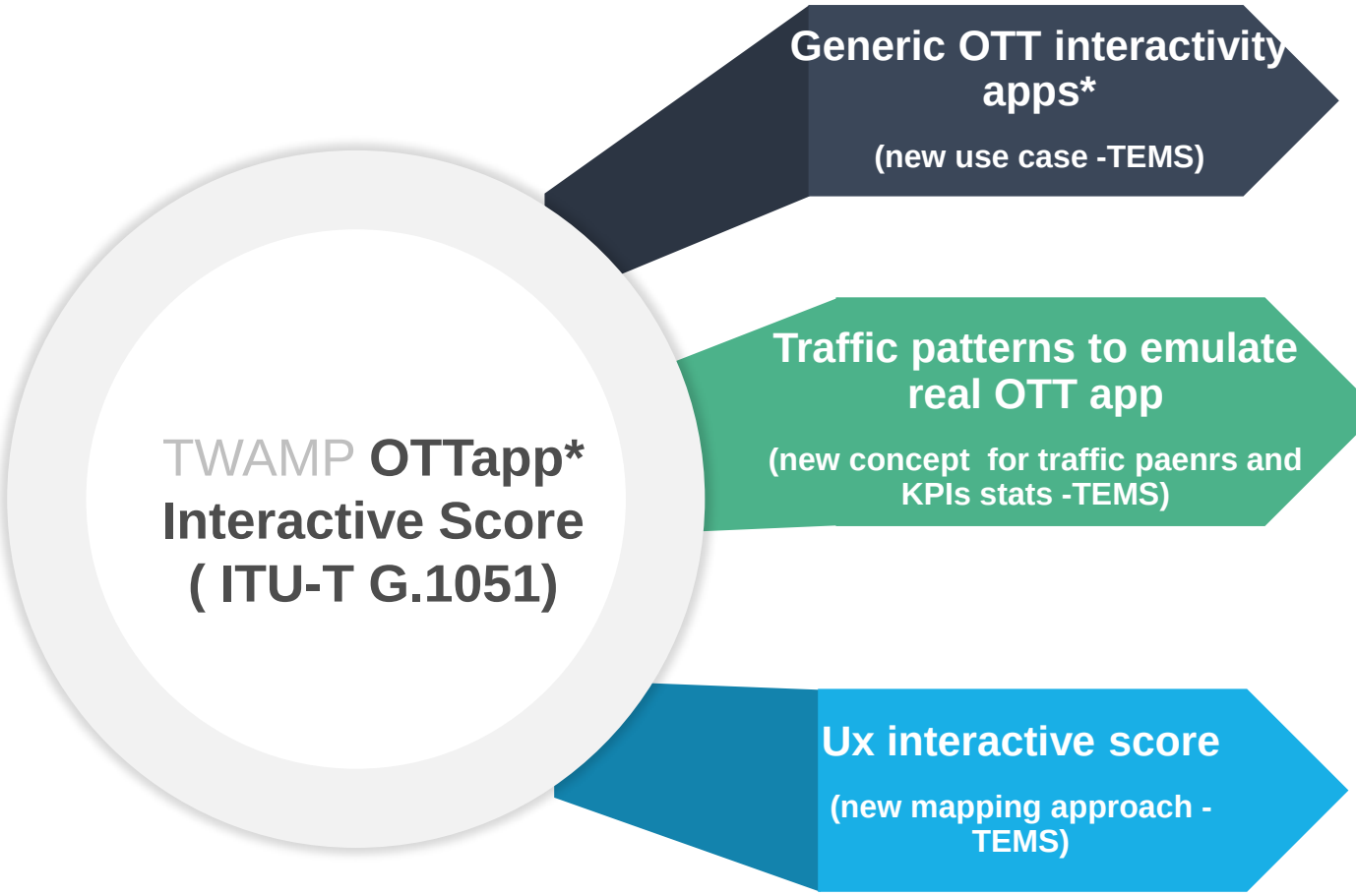
User experience (Ux) Interactivity Score

OTT interactivity quality testing (MOS scoring)



Could Gaming over Mobile (CGM**) (TEMS),** Mobile gaming (egaming), Video Chat, Remote Meeting, Remote Drone Control

(Adaptive*) traffic patters mimicking (emulating) the real OTT app using adaptive TWAMP with pre-defined packet size and packet send frequency, asymmetric UL/DL

Measurements on the traffic patterns: 2way latency (RTT), std(PDV/iPDV)**, lost packets (PL)

Interactivity Score = f (RTT, PDlv, PL) with parameterization based on

- 3GPP QoS performance thresholds, or
- subjective tests on real OTT app

** PacketDelayVariation and InterPacketDelay (or std (PDV)

TEMS cloud gaming over mobile use case
Unique characteristics*

Traffic patterns

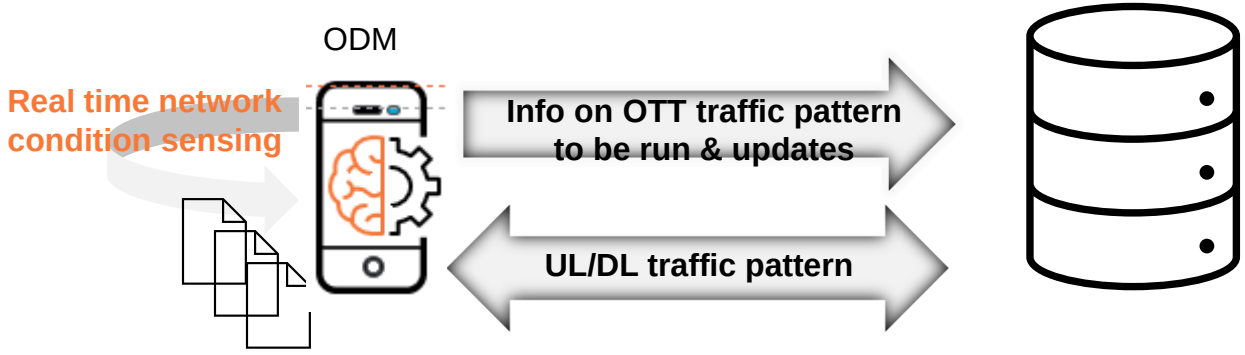
- adaptive as the real game would do, based on UE sensed network condition described by a KPI (RTT, PDV, PL) set of values
  - traffic patterns previously learnt from real OTT app analysis in different network conditions
- uplink/downlink asymmetric traffic

Interactive score

- based on subjective tests (scores obtained from gamers playing real games over broad range of network conditions)
- using the most demanding game genre (FPS/CS-GO** for ensuring optimization for the worst -case scenarios

Real time interactive score

UxIntAct=F** (RTT, std(PDV/iPDV), PL)



Traffic pattern changing with the network condition

* Vis a vis all the other ITU-T G.1051 use cases

** FPS CS-First Time Shooter, Counter Strike – Global Offense

TEMS™ user experience testing benefits

Test any OTT application

Unlike other solutions, Infovista's testing approach doesn't require customized OTT applications

ETSI compliant KPIs

The solution provides support for industry standard ETSI compliant KPIs

Commercial off-the-shelf devices

The ability to use commercial off-the-shelf (COTS) devices reduces the cost to test and time to market

Network-centric testing approach

Provides an accurate and holistic view of network quality while removing the requirement to test every device model