

Brochure

VIAVI TeraVM

Voice, Video and MPEG Transport Stream Quality Metrics

The ITU-T published J.144, a measurement of quality of service, for the transmission of television and other multimedia digital signals over cable networks. This defines the relationship between subjective assessment of video by a person and objective measurements taken from the network.

The correlation between the two are defined by two methods:

- Full Reference (Active) – A method applicable when the full reference video signal is available, and compared with the degraded signal as it passes through the network.
- No Reference (Passive) – A method applicable when no reference video signal or information is available.

VIAVI believes that a combination of both Active and Passive measurements gives the correct blend of analysis with a good trade off of accuracy and computational power. TeraVM provides both voice and video quality assessment metrics, active and passive, based on ITU-T's J.144, but are extended to support IP networks.

For active assessment of VoIP and video, both the source and degraded signals are reconstituted from ingress and egress IP streams that are transmitted across the Network Under Test (NUT).

The VoIP and video signals are aligned and each source and degraded frame is compared to rate the video quality.

For passive measurements, only the degraded signal is considered, and with specified parameters about the source (CODEC, bit-rate) a metric is produced in real-time to rate the video quality.

This combination of metrics gives the possibility of a 'passive' but lightweight Mean Opinion Score (MOS) per-subscriber for voice and video traffic, that is correlated with CPU-expensive but highly-accurate 'active' MOS scores.

Both methods provide different degrees of measurement accuracy, expressed in terms of correlation with subjective assessment results. However, the trade off is the considerable computation resources required for active assessment of video - the algorithm must decode the IP stream and reconstitute the video sequence frame by frame, and compare the input and output frames to determine its score. The passive method is less accurate, but requires less computing resources.

Active Video Analysis

The active video assessment metric is called PEVQ – Perceptual Evaluation of Video Quality. PEVQ provides MOS estimates of the video quality degradation occurring through a network by

analysing the degraded video signal output from the network. This approach is based on modelling the behaviour of the human visual tract and detecting abnormalities in the video signal quantified by a variety of KPIs. The MOS value reported, lies within a range from 1 (bad) to 5 (excellent) and is based on a multitude of perceptually motivated parameters.

To get readings from the network under test, the user runs a test with an video server (TeraVM or other) and an IGMP client, that joins the stream for a long period of time. The user selects the option to analysis the video quality, which takes a capture from both ingress and egress test ports.

Next, the user launches the TeraVM Video Analysis Server, which fetches the video files from the server, filters the traffic on the desired video channel and converts them into standard video files. The PEVQ algorithm is run and is divided up into four separate blocks.

The first block – pre-processing stage – is responsible for the spatial and temporal alignment of the reference and the impaired signal. This process makes sure, that only those frames are compared to each other that also correspond to each other.

The second block calculates the perceptual difference of the aligned signals. Perceptual means that only those differences are taken into account which are actually perceived by a human viewer. Furthermore the activity of the motion in the reference signal provides another indicator representing the temporal information. This indicator is important as it takes into account that in frame series with low activity the perception of details is much higher than in frame series with quick motion.

The third block in the figure classifies the previously calculated indicators and detects certain types of distortions.

Finally, in the fourth block all the appropriate indicators according to the detected distortions are aggregated, forming the final result – the mean opinion score (MOS). TeraVM evaluates the quality of CIF and QCIF video formats based on perceptual measurement, reliably, objectively and fast.

In addition to MOS, the algorithm reports:

- **Distortion indicators:** For a more detailed analysis the perceptual level of distortion in the luminance, chrominance and temporal domain are provided.
- **Delay:** The delay of each frame of the test signal related to the reference signal.
- **Brightness:** The brightness of the reference and degraded signal.
- **Contrast:** The contrast of the distorted and the reference sequence.
- **PSNR:** To allow for a coarse analysis of the distortions in different domains the PSNR is provided for the Y (luminance), Cb and Cr (chrominance) components separately.
- **Other KPIs:** KPIs like Blockiness (S), Jerkiness, Blurriness (S), and frame rate the complete picture of the quality estimate.

Passive MOS and MPEG Statistics

The VQM passive algorithm is integrated into TeraVM, and when required produces a VQM, an estimation of the subjective quality of the video, every second. VQM MOS scores are available as an additional statistic in the TeraVM GUI and available in real time. In addition to VQM MOS scores, MPEG streams are analysed to determine the quality of each "Packet Elementary Stream" and exports key metrics such as Packets received and Packets Lost for each distinct Video stream within the MPEG Transport Stream. All major VoIP and Video CODECs are support, including MPEG 2/4 and the H.261/3/3+/4.

Voice over IP call quality can be affected by packet loss, discards due to jitter, delay, echo and other problems. Some of these problems, notably packet loss and jitter, are time varying in nature as they are usually caused by congestion on the IP path. This can result in situations where call quality varies during the call - when viewed from the perspective of "average" impairments then the call may appear fine although it may have sounded severely impaired to the listener. TeraVM inspects every RTP packet header, estimating delay variation and emulating the behavior of a fixed or adaptive jitter buffer to determine which packets are lost or discarded. A 4- state Markov Model measures the distribution of the lost and discarded packets. Packet metrics obtained from the Jitter Buffer together with video codec information obtained from the packet stream to calculate a rich set of metrics, performance and diagnostic information. Video quality scores provide a guide to the quality of the video delivered to the user. TeraVM V3.1 produces call quality metrics, including

listening and conversational quality scores, and detailed information on the severity and distribution of packet loss and discards (due to jitter). This metric is based on the well established ITU G.107 E Model, with extensions to support time varying network impairments.

For passive VoIP analysis, TeraVM v3.1 emulates a VoIP Jitter Buffer Emulator and with a statistical Markov Model accepts RTP header information from the VoIP stream, detects lost packets and predicts which packets would be discarded – feeding this information to the Markov Model and hence to the TeraVM analysis engine.

PESQ Support

Finally, PESQ is available for the analysis of VoIP RTP Streams. The process to generate PESQ is an identical process to that of Video Quality Analysis.



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