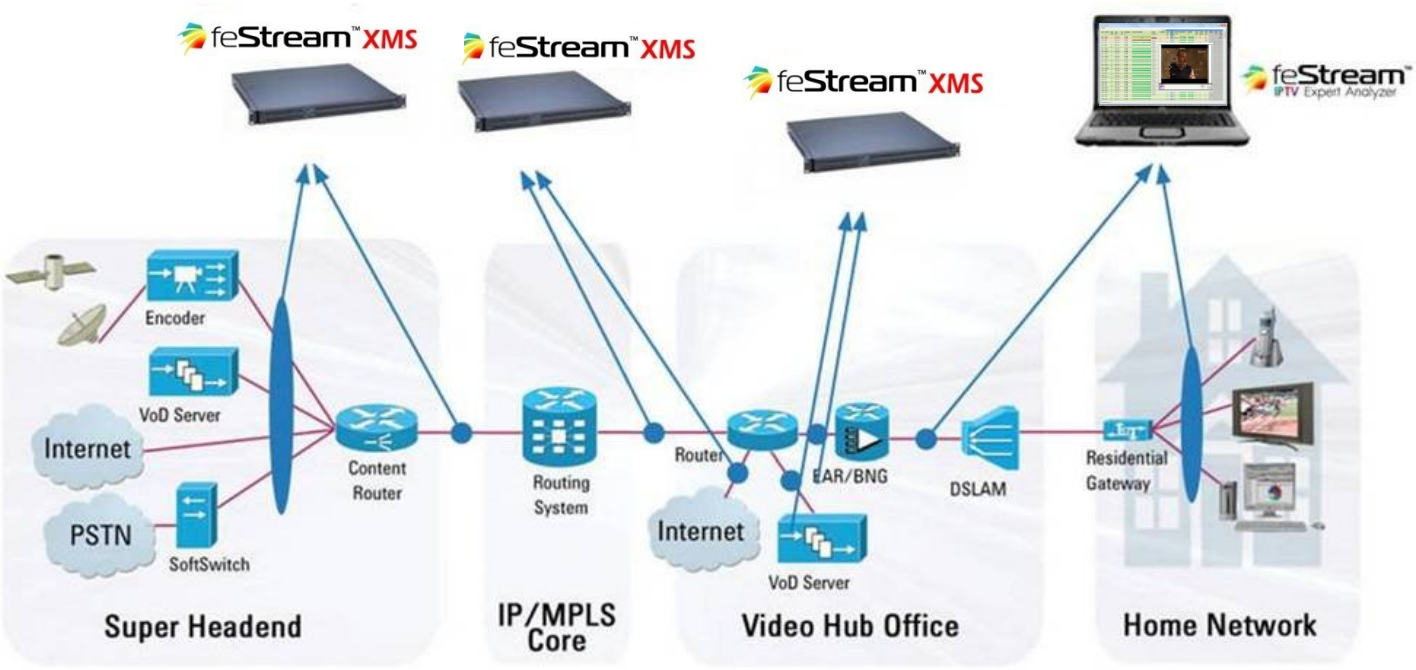
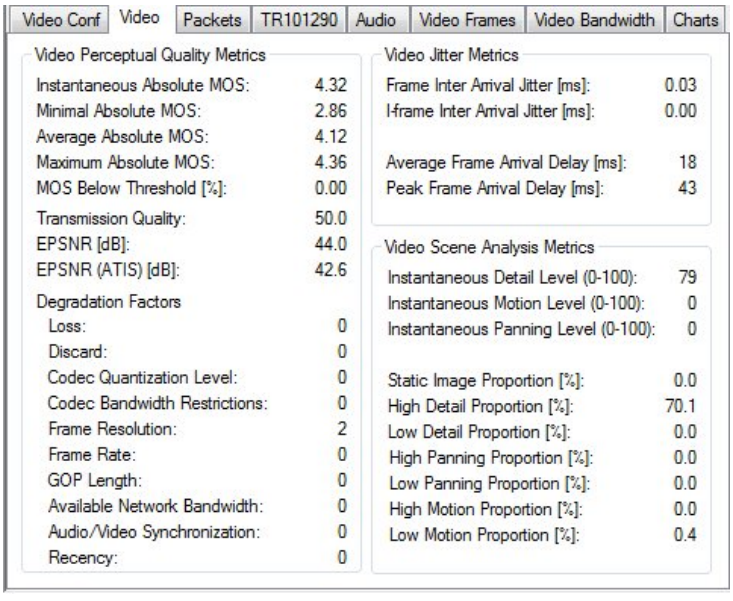
Deep Packet Inspection of Encrypted IPTV Packets with feStream Technology

The majority of IPTV monitoring systems on the market today, base their underlying technologies on the analysis of transport impairments including packet loss, packet jitter, TR 101290, PCR jitter and Media Delivery Index. While these are the legitimate impairments to measure video quality, they do not analyze deep enough to detect and measure other important factors that can impact video quality.

feStream XMS and feStream IPTV Expert Analyzer products utilize proprietary analysis technology named *feStream*. The feStream technology also provides analysis of transport impairments including packet loss, packet jitter, TR 101290 and PCR jitter. However, feStream technology can analyze much deeper to provide a suite of perceptual quality metrics to determine the QoS and QoE of the video service. It uses a powerful algorithm based on over 180 different metrics taken from the encoded video and audio MPEG-TS transport and RTP/UDP encapsulated packets to determine a MOS score for the QoE. The MOS algorithm is much more complex than Media Delivery Index but it provides a more accurate measurement of the overall QoE. In fact, feStream technology deep packet inspection is so powerful that it even has the ability to extract video quality information from encrypted video. Considering that many content vendors utilize encryption for security and privacy now, feStream technology is vital to accurately assess video quality.



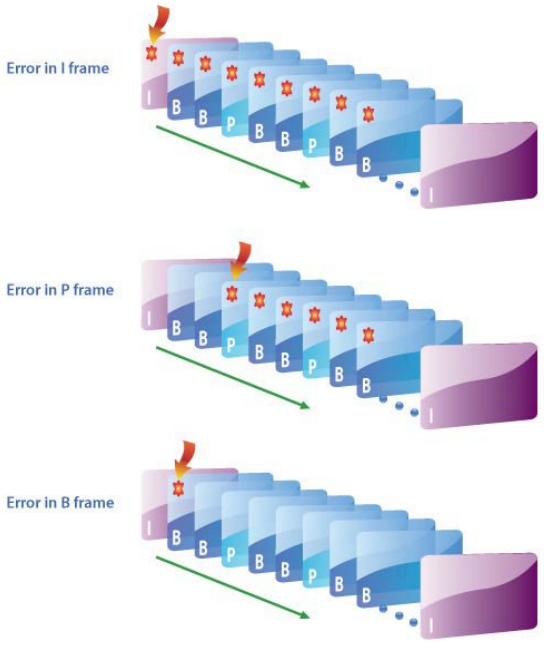


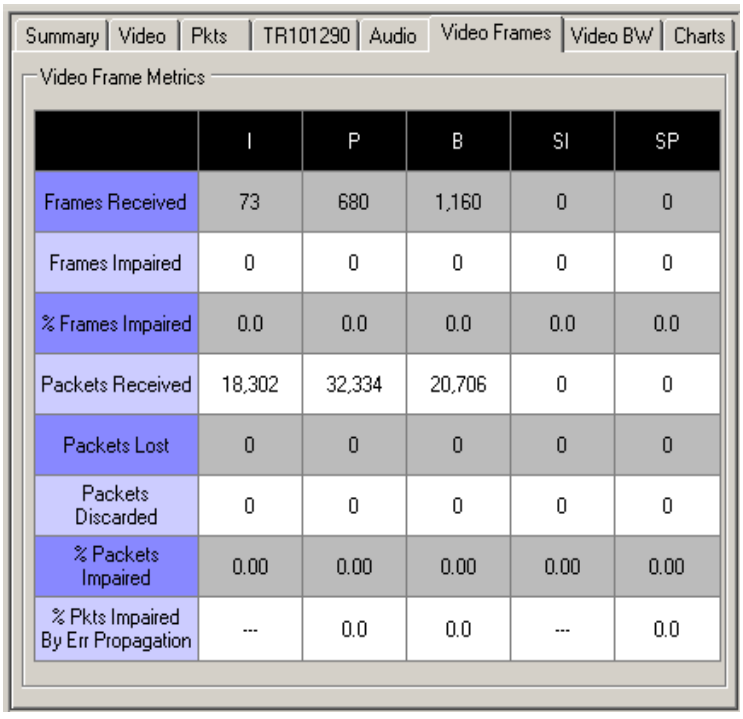
The visibility of video impairments depends partly on the video content. For instance, frame freezes tend to be more noticeable during fast-motion scenes (games and action scenes) than static scenes (news). Furthermore, perceptual quality is affected by subjective factors including human reaction time and the “recency effect”. Coupled with the type of content, e.g., fast motion, high detail, or frequent scene changes, the quality of experience for the viewer will vary even under the same impairment conditions. feStream technology performs high-level analysis of motion, detail and panning levels as shown in the example to the left in the Video Scene

Analysis Metrics. This analysis is then included in feStream's comprehensive *Video Perceptual Quality Metrics.* When the MOS score is reduced, the Degradation Factors contributing to this reduction are calculated and displayed. These Degradation Factors allow a service engineer to implement qualified actions such as increasing the allocated video bandwidth, changing the codec or other relevant changes.

Another useful parameter perceptual quality metric that feStream technology can extract from encrypted video is Estimated Peak Signal-to-Noise Ratio (EPSNR). The EPSNR is an objective measurement of video service quality that compares the maximum power of video signal to the power of any noise affecting the signal. feStream technology estimates the ESPNR based on the type of video codec, loss rate, loss distribution and other parameters. By contrast, traditional full reference, calculated PSNR, compares the output video with the input video which is complex to implement and calculate. EPSNR is measured in dB and a value of under 20dB is regarded as non-viewable.

Due to the complex structure of MPEG-TS video carried by IPTV, packet loss may cause severe quality degradation or it may pass by completely unnoticed. It depends on which frame types are affected (see the figure at the right). feStream technology can identify individual I, B, and P frames in the Group of Pictures (GOP) and calculates the impact of loss on each frame type within encrypted video packets. This process leads to Video Perceptual Quality Metrics that are significantly more accurate than those derived from overall packet loss like MDI.





	I	P	B	SI	SP
Frames Received	73	680	1,160	0	0
Frames Impaired	0	0	0	0	0
% Frames Impaired	0.0	0.0	0.0	0.0	0.0
Packets Received	18,302	32,334	20,706	0	0
Packets Lost	0	0	0	0	0
Packets Discarded	0	0	0	0	0
% Packets Impaired	0.00	0.00	0.00	0.00	0.00
% Pkts Impaired By Err Propagation	---	0.0	0.0	---	0.0

feStream technology displays the statistics for each type of encrypted video frame:

- Frames Received
- Frames Impaired
- Packets Received
- Packets Lost
- % Packets Impaired
- % Packets Impaired by Error Propagation

This information is very useful to service operators managing the headend traffic.

As mentioned above, monitoring quality of encoded video is possible with feStream technology for both encrypted and unencrypted streams. However, the affect of encryption on other quality metrics depends entirely on the type and location of the encryption.

Depending on the IPTV network design, encryption can take place at various levels:

- Encoder level
- Packet Elementary Stream (PES) level
- Transport Stream (TS) level

There are two key types of encryption:

- Joint compression encryption algorithm
- Compression-independent encryption algorithm

The encoder is the location of choice for most encryption systems. The joint compression encryption algorithm is used inside the encoder and decryption takes place inside the decoder (Set Top Box).

The compression-independent encryption algorithms can be applied;

- After the encoder
- After the video and audio PES packetizes
- After PES and TS mux

feStream technology's deep packet inspection and analysis is *not affected* by encryption using joint compression algorithm. It is easy to see why. The MPEG-TS header is not encrypted and this is the source of information for most transport metrics. In addition, feStream technology can apply heuristic analysis methods, such as video scene analysis metrics, to the encrypted PES streams. The GOP frame details and statistics for I, B and P frames are calculated.

With compression-independent encryption algorithms, the two most common encryption methods are:

- Encrypted MPEG-TS over RTP/UDP
- Encrypted MPEG-TS over UDP or TCP

The encrypted MPEG-TS over RTP is the most commonly used method. feStream technology provides accurate GOP metrics for this method since the RTP provides the video frame types in its headers.

In case of encrypted MPEG-TS over UDP or TCP accuracy of the GOP metrics is good for constant GOP format. If the GOP format varies the metrics are somewhat less accurate.

However, MOS scores will be the same in all these cases due to averaging effect.

The ability of feStream to analyze video scenes in both encrypted and unencrypted systems adds additonal value to the quality of the overall video, audio and video/audio MOS scores.