

# IxLoad – Video Test Solution

Validate Video Services to Deliver High-Quality Customer Experience

## Problem: Maintaining Video Quality When Facing Exponential Traffic Increase

As more content is offered in high definition (HD) and service providers charge a premium for it, subscribers are likely to churn faster when dissatisfied. Degradation in audio/visual quality experience leads today's consumer to competitor solutions that offer a better end user experience. With traffic levels high and expected to grow for the foreseeable future, service providers are challenged to assess video quality with real-world traffic loads in pre-deployment testing.

## Solution: A Comprehensive Test Solution for Video Delivery Platforms

IxLoad delivers the industry's most scalable and flexible solution for realistic load testing of over the top (OTT), video on demand (VoD), IPTV media, and cache platforms to validate end-to-end video delivery architectures. Emulate thousands of interactive on-demand and live streaming user sessions and measure real-time video quality.

### Key features

- Emulates adaptive streaming behavior that dynamically up-shifts or down-shifts the media stream to deterministically play back streams of different quality
- Creates static profiles of user behavior that are fixed on different playback levels to deterministically play back streams of different quality with no network heuristic at play
- Scenario editor defines subscribers' activities and flexible channel viewing sequence
- Simultaneously supports data, voice, and video protocols to emulate a multiplay subscriber environment with intelligent, real-time issue isolation mechanism

### Highlights

- Measure the ability of a transport network to carry video data
- Determine the optimal user session limits of edge and origin media servers, content proxies, etc.
- Stress-test middleware devices such as encoder systems and digital media rights management (DRM)
- Measure the perceived quality of the video delivered to the end-user
- Determine the total number of streams a content delivery network (CDN) can handle
- Test performance of key IPTV infrastructure services

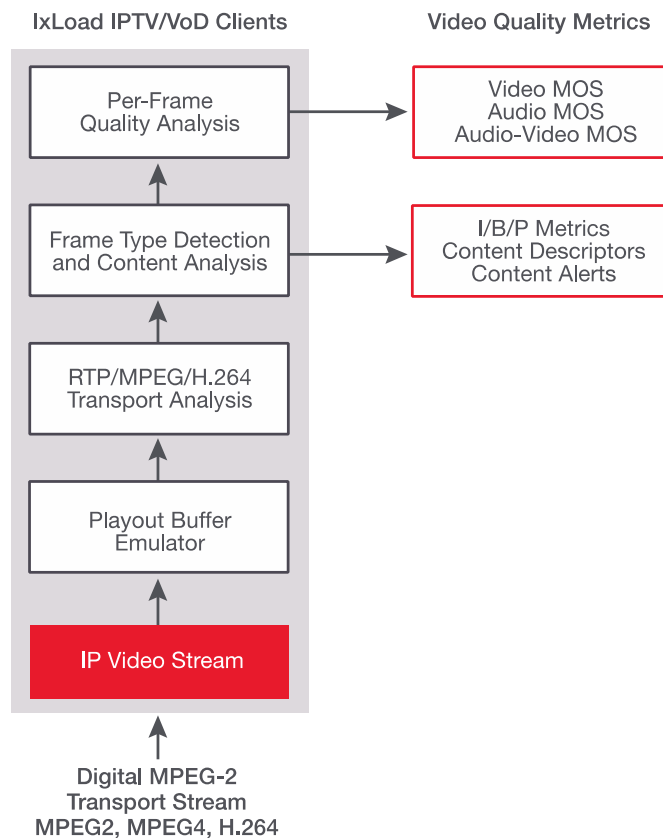
## Product Capabilities

### Video quality assessment for IPTV and VoD

IxLoad evaluates the performance of video services delivered over an IP network and provides a comprehensive solution for testing IPTV networks, video networks, and other devices that carry video traffic. IxLoad emulates true video on demand (VoD), IPTV subscribers, and video servers sending real-time full-motion video. IxLoad uses network, transport, and perceptual video quality techniques in real-time to measure the impact of delivering video over an IP network.

IxLoad makes video/audio estimations for real-time video streams using the VQmon/HD video quality algorithm. Streams can be sent unicast for video-on-demand applications, or multicast for live TV applications. IxLoad emulates a true set top box (STB) playout buffer to correctly model various environments and provides video quality metrics for all video streams across all emulated subscribers.

The following picture depicts a typical setup of an IPTV or VoD client receiving IP packets, and how the IxLoad IPTV/video client processes the packets and estimates video quality.



#### IPTV/VoD quality of experience (QoE) assessment using IxLoad

The video quality algorithm provides a comprehensive list of metrics. The following reference section details video measurement statistics and how they are used. VQmon/HD reports Relative Mean Opinion Score -Video (MOS-V) and Absolute MOS-V scores. Average scores account for all packets from the start of a stream. Interval scores account for packets since the previous statistic collection.

**Relative MOS-V** is an estimated perceptual quality score that considers the effects of codec/quantization level, the impact of IP impairments (such as packet loss) on the group of pictures (GoP) structure and video content, and the effectiveness of loss concealment methods. It does not consider the image size/resolution, frame rate, or scanning method (interlaced vs. progressive).

**Absolute MOS-V** is an estimated perceptual quality score that considers all the above-mentioned factors *as well as* image resolution, frame rate, and the use of progressive vs. interlaced scanning.

Some video formats offer inherently higher perceptual quality than others. For example, in unimpaired conditions, the quality of an HD broadcast will be higher than that of SD, 1080p better than 1080i or 720p, and 60 frames per second (fps) better than 30 fps. VQmon/HD's Absolute MOS-V score takes these factors into consideration and provides an accurate estimate of "overall" perceptual quality by considering all aspects that can impact visual quality.

Relative MOS-V provides an indication of video quality relative to the ideal for a given video format. For example, if a screen viewing a 1080p/60i or 720p/30p feed is small, then the picture quality between the two is not discernable. Therefore, the relative MOS-V is used in this context to show that if the screen sizes (and other factors) are not taken into account, then the two streams are "relatively" similar in quality.

Video Quality Assessment	
<b>Features</b>	<ul style="list-style-type: none"> <li>• Accurate video, audio, and multimedia MOS using frame-based analysis</li> <li>• Greater insight in real-time with average- and interval-based scores</li> <li>• Support for RTP and MPEG transport streams, MPEG2, MPEG4, H.264, H.265 codec</li> <li>• Analyze scrambled and encrypted streams using header information</li> <li>• Automatic detection of GoP structure, bit rate, and frame information</li> <li>• Comprehensive frame-level analysis, including IPB frames, I-Frame gap</li> <li>• Uses frame-based loss analysis to provide accurate measurements than loss alone</li> <li>• Video scene analysis gives indication on the nature of content (detail, motion, panning)</li> <li>• Due to its computational efficiency, IxLoad supports hundreds of simultaneous users and active video streams, producing MOS for video, audio, and multimedia for each stream</li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• Per Stream – Video and Bandwidth information</li> <li>• Per Stream – Absolute and Relative MOS</li> <li>• Per Stream – Frame Statistics, Scene Analysis, Transport Metrics, and Jitter Buffer</li> <li>• Conditional Statistics for User – Video Description, MOS, Frame Statistics, Stream and Frame Bandwidth, Frame and Packet Jitter, Jitter Buffer, Scene Analysis</li> </ul>

## Video quality assessment for OTT

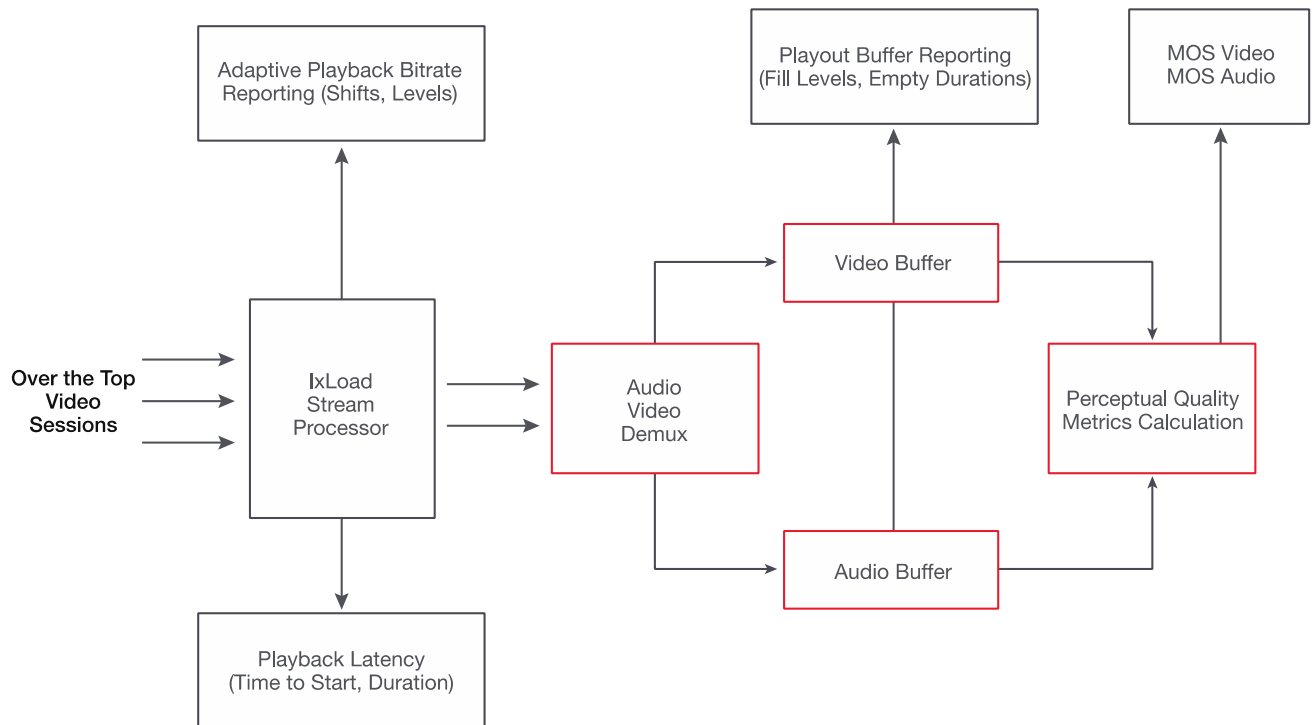
IxLoad emulates the latest OTT video playback technologies including HTTP download, Flash RTMP/RTMPT, Microsoft Silverlight, Apple HLS, Adobe HDS, and MPEG-DASH. Unlike IPTV deployments, which primarily use UDP as transport, OTT video uses HTTP/TCP. While presenting some new challenges, HTTP/TCP transport overcomes many shortcomings of video over UDP with functionality such as:

- Forward error correction (FEC) for unreliable links
- Positive or negative acknowledge of video packets using RTCP
- Sensitivity to packet loss incurred in the IP delivery network

TCP as a transport virtually guarantees no packet loss and feedback of missing segments are inherently managed by TCP. What is important as a measure of user experience in video delivery over HTTP/TCP is not the same as that of video over UDP in IPTV scenarios.

Test engineers need flexible and scalable solutions to verify OTT video performance and end user QoE. IxLoad offers such a solution, emulating the core technologies used to establish and maintain OTT video services.

The following picture depicts a typical setup of an OTT video client in IxLoad receiving IP packets, and how IxLoad processes the packets and estimates user experience.



TCP video quality assessment using IxLoad

OTT Video Quality Assessment	
<b>Features</b>	<ul style="list-style-type: none"> <li>• Accurate perceptual video and audio MOS on a scale of 1 to 5, with 5 being best</li> <li>• Playback time that measures interactive experience of the viewer and video with time to connect, start time, and total playback time</li> <li>• Client-side playout buffer analysis aptly provides insight into the network and congestion</li> <li>• TCP metrics including timeout, retries, total bitrate, and session-level streams</li> <li>• Adaptive bitrate profile for all players provides instant view of the quality of media playback</li> <li>• See the impact of network congestion on mobile device buffers and how it impacts user experience with video freeze and pauses</li> <li>• Visualize the levels of bitrate from the streamed manifests to ascertain the quality of video playback using Ixia's automatic adaptive algorithm</li> <li>• Determine user's perceived content availability and interactivity with video by examining time to start, buffering time spent, and total playback time compared to video's actual duration</li> <li>• Analyze server-to-client traffic to determine transport network's ability to carry video over HTTP/TCP</li> <li>• Qualify the integration and configuration of network traffic optimizers, such as video transcoders, through subjective video/audio quality metrics</li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• Playout Buffer Analysis Statistics</li> <li>• Playback Time Statistics</li> <li>• Visual Quality Statistics</li> </ul>

## Specifications

VOD	
<b>IP Support</b>	IPv4 and IPv6
<b>Emulation</b>	<ul style="list-style-type: none"> <li>• Emulation of subscribers</li> <li>• Emulation of high-performance VoD servers</li> <li>• Media streams over raw UDP and RTP/UDP</li> <li>• RTCP RR support on VoD clients</li> <li>• Proxy support</li> <li>• Redirect</li> </ul>
<b>RTSP Commands User Playback</b>	DESCRIBE, SETUP, PLAY, TEARDOWN, PAUSE, RESUME, SEEK (back, forth), FF and REWIND (Trick Play), PlayStatic (SETUP, PLAY, TEARDOWN), GET_PARAMETER (Keep-alive), SET_PARAMETER, ANNOUNCE processing (when sent by external server)

VOD	
<b>Video Codecs</b>	<ul style="list-style-type: none"> <li>• MPEG2, MPEG4, H.264 over MPEG2-TS streams</li> <li>• Native transport of MPEG4 and H264 content</li> <li>• Single-program (SPTS) and multi-program transport streams (MPTS)</li> </ul>
<b>Quality of Experience</b>	<ul style="list-style-type: none"> <li>• Transport-level video quality metrics including packet loss, jitter, and MDI</li> <li>• Perceptual video quality metrics using TVQM (MOS_V)</li> <li>• Subscriber-level video quality metrics</li> <li>• Video-level statistics, including IPB frames received and impaired</li> <li>• STB jitter buffer emulation (JBE) to model impact on video quality</li> </ul>
<b>Real-world Testing</b>	<ul style="list-style-type: none"> <li>• Flexible RTSP implementation</li> <li>• Customizable headers allow interaction with leading VoD systems</li> <li>• Mix IPTV, voice and data traffic in the same test</li> <li>• Support for RTP/UDP or UDP for video transmission</li> <li>• Support for thousands of digital assets using sequence generators</li> <li>• Standard definition (SD) and HD content</li> <li>• Configurable DSCP bit settings per stream on the VoD server</li> <li>• Configurable DSCP bit settings for RTSP messages</li> </ul>
<b>Media Name</b>	<ul style="list-style-type: none"> <li>• Configurable on a per playback command basis</li> </ul>
<b>Streaming Media Files</b>	<ul style="list-style-type: none"> <li>• User supplied Transport Stream files</li> <li>• MP4 contained files</li> <li>• Synthetic CBR streams</li> <li>• Sample SD and HD video files supplied</li> </ul>
<b>STB Buffer emulation</b>	<ul style="list-style-type: none"> <li>• Configurable globally</li> <li>• Update interval (for statistics)</li> <li>• Nominal Delay (ms)</li> <li>• Buffer size (packets)</li> </ul>
<b>Performance Metrics</b>	<ul style="list-style-type: none"> <li>• Active stream count</li> <li>• Throughput (RX, TX)</li> <li>• HTTP connection and transaction-level statistics</li> <li>• HTTP Error Response tracking (e.g. 404, 503)</li> <li>• Manifest Requests</li> <li>• Fragments for Audio and Video Requests</li> <li>• Bit-rate Shift Requests</li> </ul>
<b>Features</b>	<ul style="list-style-type: none"> <li>• Benchmark the performance of video servers</li> <li>• Determine throughput, session capacity, and network performance</li> <li>• Measure VoD management system response times</li> </ul>

VOD	
	<ul style="list-style-type: none"> <li>• Stress server resources through the use of playback controls</li> <li>• Measure HD streaming performance</li> <li>• Do capacity planning of clustered VoD systems</li> <li>• Measure unicast routing performance of service routers</li> <li>• Certify network QoS for VoD</li> <li>• Measure subscriber's QoE</li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• 100+ VoD Client Statistics</li> <li>• 30+ VoD Server Statistics</li> </ul>

IPTV	
<b>IP Support</b>	IPv4 and IPv6
<b>Emulation</b>	<ul style="list-style-type: none"> <li>• Emulation of Broadcast IPTV and VoD IPTV subscribers</li> <li>• Support for IPv4 using IGMPv1, IGMPv2 and IGMPv3</li> <li>• Support for IPv6 using MLDv1 and MLDv2</li> </ul>
<b>Video Codecs</b>	<ul style="list-style-type: none"> <li>• MPEG2, MPEG4, H.264 and others over MPEG2-TS streams</li> <li>• MPEG4, H.264 and WM9 (advanced video bundle)</li> <li>• Support for native MPEG4 transport of High definition streams</li> <li>• Support for SPT and MPTS</li> </ul>
<b>Quality of Experience</b>	<ul style="list-style-type: none"> <li>• Video quality metrics to measure both transmission quality using MDI and perceptual video quality using TVQM</li> <li>• Video quality metrics on a per-subscriber basis</li> <li>• Per-video stream statistics such as jitter, latency, loss, bit rates</li> <li>• MPEG-level statistics on number of I, B and P frames received per video stream</li> <li>• Support for jitter buffer emulation to model and characterize STB behavior</li> <li>• Digital Video Broadcasting video quality measurements as described in ETSI TR 101 290</li> </ul>
<b>Real-world Testing</b>	<ul style="list-style-type: none"> <li>• Mix IPTV, voice, and data traffic in the same test</li> <li>• Support for RTP/UDP or UDP for video transmission</li> <li>• Near wire-speed video transmission with very low jitter</li> <li>• Channel change performance testing with Join and Leave latency measurements on a per-subscriber basis</li> <li>• Support for interleaving multicast and VoD commands on client</li> <li>• Support for user-specified video files or synthetic data using IxLoad servers</li> </ul>

IPTV	
	<ul style="list-style-type: none"> <li>• Channel viewing sequences such as sequential, concurrent, and random for user-realism</li> <li>• Channel viewing profiles based on statistical distribution models for prime-time emulation</li> <li>• Support for channel switch delay emulation</li> <li>• Customizable client headers</li> <li>• Configurable TOS and DSCP bit settings</li> </ul>
<b>Features</b>	<ul style="list-style-type: none"> <li>• Subscriber simulation with Instant Channel Change behavior</li> <li>• Key performance metrics, including transport and perceptual video quality scores</li> <li>• Determine the ability of a transport network to carry triple-play traffic</li> <li>• Measure the impact of network characteristics on video quality</li> <li>• Measure the perceived quality of video delivered to the subscriber</li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• 140+ Client Statistics</li> <li>• 45+ Server Statistics</li> </ul>

MS IPTV	
<b>IP Support</b>	IPv4 and IPv6
<b>Emulation</b>	<ul style="list-style-type: none"> <li>• Simulation of large numbers of MS IPTV-like STBs per port, with the ability to scale to hundreds of ports</li> <li>• Client <ul style="list-style-type: none"> <li>○ Simulation of Instant Channel Change behavior</li> <li>○ Simulation of on-demand clients</li> </ul> </li> <li>• Server <ul style="list-style-type: none"> <li>○ Simulation of ICC behavior of A and D servers</li> <li>○ Simulation of V server for on-demand operation</li> </ul> </li> </ul>
<b>Content</b>	<ul style="list-style-type: none"> <li>• Synthetic and real payloads (MPEG2, MPEG4, H.264, VC-1)</li> </ul>
<b>Features</b>	<ul style="list-style-type: none"> <li>• Automatic selection of A and D server configured channel selections</li> <li>• Channel viewing sequences to emulate channel watching patterns</li> <li>• Channel selection to create random and prime-time scenarios</li> <li>• Distributed architecture to support hundreds of D servers</li> <li>• Synchronization between A and D servers</li> <li>• Single and multiple program transport stream, SPTS, MPTS</li> <li>• RTP/UDP, UDP</li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• 15+ MS-IPTV Client &amp; Server Statistics</li> </ul>



Flash Player	
<b>IP Support</b>	IPv4
<b>Emulation</b>	<ul style="list-style-type: none"> <li>• RTMP Client protocol</li> <li>• RTMPT with Proxy support</li> </ul>
<b>Interoperability</b>	<ul style="list-style-type: none"> <li>• Flash Media Server 3.x and third-party Flash-compatible media servers</li> </ul>
<b>Stream Handling</b>	Playback of recorded and live streams
<b>User Playback</b>	PLAY, PAUSE, RESUME, SEEK (back and forward)
<b>File playback</b>	FLV, F4V, MP3, M4V and MP4
<b>Command Configuration</b>	<ul style="list-style-type: none"> <li>• Destination Server: IP: PORT, FQDN, Hostname</li> <li>• Play Duration: Automatic (until end), or user configurable range</li> </ul>
<b>Application Name</b>	Configurable on a per-playback command basis
<b>Media Name</b>	Configurable on a per-playback command basis
<b>Features</b>	<ul style="list-style-type: none"> <li>• Create large-scale Flash Player user sessions for load testing of devices and networks to measure throughput capacity with reliable delivery of streams</li> <li>• Interact with Flash-compatible media servers, content replication, and proxy devices, and content load balancers.</li> <li>• Determine optimal user session limits of edge and origin media servers, content proxy, caching systems, and media load balancers</li> <li>• Determine the total number of streams a content delivery network (CDN) can handle with consistent and reliable stream delivery</li> <li>• Measure end user QoE of the stream playback</li> <li>• Client emulation of web-based and mobile Flash Players to “watch” streaming content</li> <li>• Support for the playback of recorded media and live streaming media</li> <li>• Interactive user actions such as playback, mid-stream pause, and seek back or forward freely to any point to stress test critical functionalities of media servers</li> <li>• Playback of an extensive list of audio and video codecs, including HD and H.264 content</li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• Test Objective Statistics, Handshake Statistics</li> <li>• NetConnection Statistics, Command Statistics</li> <li>• Error Statistics, Latency Statistics, Throughput Statistics</li> </ul>

Silverlight Player	
<b>IP Support</b>	IPv4
<b>Emulation</b>	<ul style="list-style-type: none"> <li>• Silverlight Basic Media Player Client</li> <li>• All messages sent over HTTP</li> </ul>
<b>Interoperability</b>	IIS7 with Smooth Streaming, Wowza Media Server, and other Silverlight-compatible media delivery platforms
<b>Stream Handling</b>	Playback of recorded and live streams, including timeshift support
<b>User Playback</b>	PLAY
<b>File playback</b>	Any media delivered using Silverlight technology
<b>Command Configuration</b>	<ul style="list-style-type: none"> <li>• Destination Server: IP: PORT, FQDN, Hostname</li> <li>• Play Duration: Automatic (until end), or user configurable range</li> </ul>
<b>Media Name</b>	Configurable on a per-playback command basis
<b>Buffer</b>	Configurable on a per-Silverlight-emulation basis, in seconds
<b>Features</b>	<ul style="list-style-type: none"> <li>• High performance client emulation to scale to thousands of Silverlight video players</li> <li>• Dynamic parsing of Manifest files</li> <li>• Support for playback of on-demand and live media streams</li> <li>• Full support to follow HTTP redirection to receive content from streamers and origin servers</li> <li>• Adaptive algorithm model upshifts, and downshifts based on network conditions</li> <li>• Buffer configuration in seconds and fragment requests to fill the buffer</li> <li>• HTTP proxy support to test content cache systems</li> <li>• Used in conjunction with MS IIS7 with Media Extension and Silverlight streaming compatible media servers, content replication, and proxy devices, and content load balancers.</li> <li>• Create large-scale Silverlight Player user sessions for load testing of devices and networks, to measure throughput capacity with reliable delivery of streams.</li> <li>• Emulate smooth streaming behavior that dynamically up-shifts or down-shifts the media stream to deterministically playback streams of different quality.</li> <li>• Determine the optimal user session limits of edge and origin media servers, content proxy, caching systems, and media load balancers.</li> <li>• Determine the total number of streams a content delivery network (CDN) can handle with consistent and reliable stream delivery</li> </ul>

Silverlight Player	
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• Active stream count, Throughput (RX, TX)</li> <li>• HTTP connection and transaction-level statistics</li> <li>• HTTP Error Response tracking (e.g., 404, 503)</li> <li>• Manifest Requests</li> <li>• Fragments for Audio and Video Requests</li> <li>• Bit-rate Shift Requests, Test Objective statistics</li> <li>• Manifest statistics, Fragment statistics</li> <li>• Bitrate Shifts, Bitrate statistics</li> <li>• Audio statistics, Video statistics</li> <li>• Miscellaneous statistics</li> <li>• TCP statistics, Error Statistics, Throughput Statistics</li> </ul>

HLS	
<b>IP Support</b>	IPv4
<b>Transport</b>	<ul style="list-style-type: none"> <li>• TCP, TLS, or QUIC</li> </ul>
<b>Emulation</b>	<ul style="list-style-type: none"> <li>• HLS Basic Media Player Client</li> <li>• All messages sent over HTTP/HTTPS</li> <li>• HLS QUIC Server</li> </ul>
<b>Interoperability</b>	YouTube, Wowza Media Server, and other HLS-compatible media delivery platforms
<b>Stream Handling</b>	Playback of recorded and live streams, including timeshift support
<b>User Playback</b>	PLAY
<b>File playback</b>	Any media delivered using HLS technology
<b>Command Configuration</b>	<ul style="list-style-type: none"> <li>• Destination Server: IP: PORT, FQDN, Hostname</li> <li>• Play Duration: Automatic (until end), or user configurable range</li> </ul>
<b>Media Name</b>	Configurable on a per-playback command basis
<b>Buffer</b>	Configurable on a per-HLS emulation basis, in seconds
<b>Features</b>	<ul style="list-style-type: none"> <li>• High performance client emulation to scale and emulate behavior of thousands of iOS™-based devices</li> <li>• Dynamic parsing of static, secondary and dynamic Playlist files</li> <li>• Support for playback of on-demand and live media streams</li> <li>• Full support to follow HTTP redirection to receive content from streamers and origin servers</li> </ul>

HLS	
	<ul style="list-style-type: none"> <li>• Adaptive algorithm models upshifts and downshifts based on network conditions</li> <li>• Real-time assessment of quality levels during playback</li> <li>• Buffer configuration in seconds and fragment requests to fill the buffer</li> <li>• HTTP proxy support to test content cache systems</li> <li>• Use in conjunction with HLS-compatible media servers, content replication, and proxy devices, and content load balancers</li> <li>• Create large-scale HLS Player user sessions for load testing of devices and networks in order to measure throughput capacity with reliable delivery of streams</li> <li>• Emulate adaptive streaming behavior that dynamically up-shifts or down-shifts the media stream in order to deterministically playback streams of different quality</li> <li>• Determine the optimal user session limits of edge and origin media servers, content proxy, caching systems, and media load balancers</li> <li>• Determine the total number of streams a content delivery network (CDN) can handle with consistent and reliable stream delivery</li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• Active stream count, Throughput (RX, TX)</li> <li>• HTTP connection and transaction-level statistics</li> <li>• HTTP Error Response tracking (e.g. 404, 503)</li> <li>• Playlist Requests</li> <li>• Segment for Audio and Video Requests</li> <li>• Bit-rate Shift Requests, Test Objective statistics</li> <li>• Playlist statistics, Segment statistics</li> <li>• Bitrate Shifts, Bitrate Statistics</li> <li>• Monitored User Statistics, Key Request statistics</li> <li>• Timeshift statistics, TCP statistics</li> <li>• HTTP latencies, Error statistics</li> <li>• Throughput statistics, Video Quality statistics</li> <li>• MOS statistics, Distribution of Users per Quality</li> </ul>

HDS	
<b>IP Support</b>	IPv4
<b>Emulation</b>	<ul style="list-style-type: none"> <li>• HDS Basic Media Player Client</li> <li>• All messages sent over HTTP</li> </ul>
<b>Interoperability</b>	Adobe Flash Media Server 4.5, Wowza Media Server and other HDS-compatible media delivery platforms
<b>Stream Handling</b>	Playback of recorded and live streams

HDS	
<b>User Playback</b>	PLAY
<b>File playback</b>	Any media delivered using HDS technology
<b>Command Configuration</b>	<ul style="list-style-type: none"> <li>• Destination Server: IP: PORT, FQDN, Hostname</li> <li>• Play Duration: Automatic (until end), or user configurable range</li> </ul>
<b>Media Name</b>	Configurable on a per-playback command basis
<b>Playout Buffer</b>	Configurable on a per-HDS emulation basis, in seconds
<b>Features</b>	<ul style="list-style-type: none"> <li>• High performance client emulation to scale to thousands of HDS players</li> <li>• Processing of F4M format manifest and F4F media fragments</li> <li>• Live and on-demand playback with full playout buffer configuration</li> <li>• Adaptive streaming that upshifts and downshifts based on network conditions</li> <li>• Real-time assessment of quality levels during playback</li> <li>• HTTP proxy support to test content cache systems</li> <li>• Create large-scale user sessions for load testing of devices and networks, in order to measure throughput capacity with reliable delivery of streams</li> <li>• Validate performance of real media servers to quantify their ability to handle peak number of active streaming sessions and throughput</li> <li>• Emulate adaptive streaming nature of real devices which examine network bandwidth availability to play content from the closest matching quality level</li> <li>• Create profile of user behavior that is fixed on different playback levels in order to deterministically playback streams of different quality with no network heuristic at play</li> <li>• Determine the optimal user session limits of edge and origin media servers, content proxy, caching systems, and media load balancers</li> <li>• Determine the total number of streams a content delivery network (CDN) can handle with consistent and reliable stream delivery</li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• Active stream count, Throughput (RX, TX)</li> <li>• HTTP connection and transaction-level statistics, including error codes</li> <li>• HTTP Error Response tracking (e.g. 404, 503)</li> <li>• Video quality playback levels across all users</li> <li>• Counts for Manifest, fragments for Audio and Video Requests</li> <li>• Test Objective statistics, Manifest statistics</li> <li>• Fragment statistics, Bitrate Shifts</li> <li>• Playback Quality Assessment of Users</li> <li>• TCP statistics, Error Statistics, Throughput Statistics</li> </ul>

MPEG-DASH	
<b>IP Support</b>	IPv4
<b>Transport</b>	TCP, TLS, or QUIC
<b>Emulation</b>	<ul style="list-style-type: none"> <li>• DASH Basic Media Player Client</li> <li>• All messages sent over HTTP/HTTPS</li> <li>• DASH QUIC Server</li> </ul>
<b>Interoperability</b>	YouTube, Wowza Streaming Engine and other DASH-compatible media delivery platforms
<b>Stream Handling</b>	Playback of recorded and live streams
<b>User Playback</b>	PLAY
<b>File playback</b>	Any media delivered using DASH technology
<b>Command Configuration</b>	<ul style="list-style-type: none"> <li>• Destination Server: IP: PORT, FQDN, Hostname</li> <li>• Play Duration: Automatic (until end), or user configurable range</li> </ul>
<b>Media Name</b>	Configurable on a per-playback command basis
<b>Buffer</b>	Configurable on a per-DASH emulation basis, in seconds
<b>Features</b>	<ul style="list-style-type: none"> <li>• High-performance client emulation to scale and emulate behavior of thousands of MPEG-DASH clients</li> <li>• Dynamic parsing of static and dynamic (live) MPD files</li> <li>• Support for playback of on-demand and live media streams</li> <li>• Adaptive algorithm models up-shift and down-shift based on network conditions</li> <li>• Full support to follow HTTP redirection to receive content from streamers and origin servers</li> <li>• Extensive real-time statistics including detailed TCP and HTTP stats</li> <li>• Buffer configuration in seconds and fragment requests to fill the buffer</li> <li>• HTTP proxy support to test content cache systems</li> <li>• Create large-scale MPEG DASH user sessions for load testing of devices and networks, to measure throughput capacity with reliable delivery of streams</li> <li>• Use in conjunction with MPEG-DASH-compatible media servers, content replication, and proxy devices; and with content load balancers</li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• Active stream count, Throughput (RX, TX)</li> <li>• HTTP connection and transaction-level statistics</li> <li>• HTTP Error Response tracking (e.g. 404, 503)</li> <li>• MPD Requests, Video, Audio, and Text segment statistics</li> <li>• Bit-rate Shift Requests, Test Objective statistics</li> </ul>

MPEG-DASH	
	<ul style="list-style-type: none"> <li>• Media presentations, Video segments</li> <li>• Audio segments, Text segments</li> <li>• Initialize segments, Redirects</li> <li>• Upshifts, Downshifts, Segment bitrates, HTTP Statistics</li> </ul>

## Platform Options

Visit Keysight.com for More Information on IxLoad Platform Options	
<b>Virtual Platform</b>	<ul style="list-style-type: none"> <li>• IxLoad Virtual Edition (VE)</li> </ul>
<b>Chassis</b>	<ul style="list-style-type: none"> <li>• XGS-12 HSL/SD/SDL Chassis</li> <li>• XGS-2 HSL/SD/SDL Chassis</li> </ul>
<b>Load Modules</b>	<ul style="list-style-type: none"> <li>• CloudStorm Fusion 10GE, 40GE, 25GE, &amp; 100GE</li> <li>• CloudStorm 10GE, 40GE, 25GE, &amp; 100GE</li> <li>• PerfectStorm Fusion 10/1GE, 40GE &amp; 100GE</li> <li>• PerfectStorm 10/1GE, 40GE &amp; 100GE</li> <li>• Novus-NP 10G/1G/100M</li> <li>• Novus 10G/1G/100M</li> <li>• Novus 10G/5G/2.5G/1G/100M</li> </ul>
<b>Appliances</b>	<ul style="list-style-type: none"> <li>• PerfectStorm ONE Fusion 10/1GE, 40GE &amp; 100GE</li> <li>• PerfectStorm ONE 10/1GE, 40GE &amp; 100GE</li> <li>• Novus ONE Appliance</li> <li>• Novus ONE Plus Appliance</li> </ul>

## Technology Solutions

Visit Keysight.Com for More Information on IxLoad Technology Solutions	
	<ul style="list-style-type: none"> <li>• IxLoad Overview—Converged Multiplay Service Validation</li> <li>• IxLoad Virtual Edition (VE) L4-7 Application Performance Testing</li> <li>• IxLoad Data Test Solution</li> <li>• IxLoad Video Test Solution</li> <li>• IxLoad Voice Test Solution</li> <li>• IxLoad IPsec and Network Access Test Solution</li> <li>• IxLoad on AWS – Cloud Application Performance Testing</li> <li>• IxLoad on Azure – Cloud Application Performance Testing</li> </ul>

## IxLoad Ordering Information

### Chassis licenses

Part Number	Description
<p><b>925-3371</b></p>	<p>IxLoad Multiplay-Security-2016, Software Bundle, Layer 4-7 Performance Test Application Data-Video-Voice-Security package. Includes:</p> <ul style="list-style-type: none"> <li>• <b>Data:</b> Enables support for HTTP, HTTPS, TCP Session, FTP, DNS, Mail (SMTP, POP3 and IMAP), Database, SSH, RADIUS, TFTP, Application-Replay, DHCP, LDAP, Telnet, Stateless-Peer and StreamBlaster emulations</li> <li>• <b>Video:</b> Enables support for basic RTSP, IPTV (Multicast), Video-ADVANCED (VoD), Adobe Flash Client, Apple HLS Client, Microsoft Silverlight Client, Adobe HDS Client and DASH Client emulations. Includes Video Quality VQMON engine for up to 10Gbps and TCP VQ Video quality for TCP video traffic for up to 10 Gbps</li> <li>• <b>Voice:</b> Advanced VoIP SIP &amp; RTP, Audio Codecs, VoLTE extensions, and Bulk SIP &amp; MGCP. Includes: Voice Quality engine for up to 10Gbps, Video Quality engine for up to 10Gbps conversational video traffic</li> <li>• <b>ADVNET:</b> Enables support for Advanced Access networking protocols such as DHCP for IP address acquisition, DHCP Server, PPP, L2TP and IPsec</li> <li>• <b>Storage:</b> iSCSI, CIFSv1, CIFSv2 (SMB2), SMB3, NFSv3 Client, NFSv4 Client, NFS4.1 Client, Cloud Storage Client, DCBX, FCoE and FC; Note the FCoE and FC emulation is only supported on selected load modules</li> <li>• <b>Access:</b> DHCP, PPP, L2TP, L2TP, IPsec, IPsec Performance Benchmarking QuickTest &amp; SuiteB Cryptographic, 6RD, DSLITE and IPv6 SLAAC, 8021X, NAC and WEBAUTH</li> <li>• <b>Security:</b> Enables support for a collection of vulnerabilities and malware attacks with 1-year subscription service and DDoSv2</li> <li>• Software Impairment</li> </ul> <p>Note: some of the features are available only on specific load modules</p>
<p><b>925-3338</b></p>	<p><b>IxLoad-Video-IPTV-2016</b>, Software Bundle, Layer 4-7 Performance Test Application; Enables support for basic RTSP, IPTV (Multicast), Video-ADVANCED (VoD). Includes 925-3189 Video Quality VQMON engine for up to 10Gbps, ADVNET-DHCP to emulate DHCP enabled clients, Analyzer and Software Impairment on selected hardware</p>
<p><b>925-3339</b></p>	<p><b>IxLoad-Video-OTT-2016</b>, Software Bundle, Layer 4-7 Performance Test Application; Enables support for Adobe Flash Client, Apple HLS Client, Microsoft Silverlight Client, Adobe HDS Client and DASH Client emulations to validate OTT infrastructures. Includes 925-3193 TCP VQ - Video quality for TCP video traffic for up to 10 Gbps. Also includes AVDNET-DHCP to emulate DHCP enabled clients, Analyzer and Software Impairment on selected hardware</p>



## Appliance licenses

Part Number	Description
925-6321	<p><b>IxLoad Appliance Multiplay</b>, Software Bundle, Layer 4-7 Performance Test Application. Enables <b>Data, Storage, Voice, Video and Access &amp; VPN</b> on PerfectStorm ONE and Novus ONE appliances. Includes:</p> <ul style="list-style-type: none"> <li>• 925-6121 IxLoad Appliance <b>DATA &amp; Storage</b></li> <li>• 925-6112 IxLoad Appliance <b>VIDEO</b></li> <li>• 925-6113 IxLoad Appliance <b>VOICE</b></li> <li>• 925-6117 IxLoad Appliance <b>ACCESS &amp; VPN</b></li> </ul>
925-6112	<p><b>IxLoad Appliance VIDEO</b>, Software Bundle, Layer 4-7 Performance Test Application. Enables IxLoad Video functionality on PerfectStorm ONE and Novus ONE appliances. Includes: RTSP, IPTV, Video-ADVANCED, FLASH, APPLE HLS, Silverlight, Adobe HDS, MPEG-DASH, 925-3189 Video Quality VQMON engine for up to 10Gbps, 925-3193 TCP VQ - Video quality for TCP video traffic for up to 10 Gbps</p>

## Virtual edition licenses

Part Number	Description
939-9513	<p><b>IxLoad VE Tier-3 1G Floating SUBSCRIPTION</b> License. Includes the following IxLoad protocols supported on IxLoad VE for a duration of 1-Year: Data (HTTP, HTTPS, FTP, TFTP, DNS, DHCP, LDAP, Radius), Mail (IMAP, POP3, SMTP), Storage (SMB, NFS, iSCSI, Storage I/O), Voice (VoIP SIP, VoLTE), Video (DASH, Flash, HDS, HLS, IPTV VoD, MS IPTV, Silverlight), IPsec, IxLoad- Attack and IxLoad-AppLibrary. Enables 1 Gig throughput per unit</p>
939-9533	<p><b>IxLoad VE Tier-3 10G Floating SUBSCRIPTION</b> License. Includes the following IxLoad protocols supported on IxLoad VE for a duration of 1-Year: Data (HTTP, HTTPS, FTP, TFTP, DNS, DHCP, LDAP, Radius), Mail (IMAP, POP3, SMTP), Storage (SMB, NFS, iSCSI, Storage I/O), Voice (VoIP SIP, VoLTE), Video (DASH, Flash, HDS, HLS, IPTV VoD, MS IPTV, Silverlight), Ipsec, IxLoad- Attack and IxLoad-AppLibrary. Enables 10 Gig throughput per unit</p>
939-9514	<p><b>IxLoad VE Tier-4 1G Floating SUBSCRIPTION</b> License. Includes the following IxLoad protocols supported on IxLoad VE for a duration of 1-Year: Data (HTTP, HTTPS, FTP, TFTP, DNS, DHCP, LDAP, Radius), Mail (IMAP, POP3, SMTP), Storage (SMB, NFS, iSCSI, Storage I/O), Voice (VoIP SIP, VoLTE), Video (DASH, Flash, HDS, HLS, IPTV VoD, MS IPTV, Silverlight), IPsec, IxLoad- Attack and IxLoad-AppLibrary. Includes EPC and Wi-Fi Offload protocols. Enables 1 Gig throughput per unit</p>
939-9534	<p><b>IxLoad VE Tier-4 10G Floating SUBSCRIPTION</b> License. Includes the following IxLoad protocols supported on IxLoad VE for a duration of 1-Year: Data (HTTP, HTTPS, FTP, TFTP, DNS, DHCP, LDAP, Radius), Mail (IMAP, POP3, SMTP), Storage (SMB, NFS, iSCSI, Storage I/O), Voice (VoIP SIP, VoLTE), Video (DASH, Flash, HDS, HLS, IPTV VoD, MS IPTV, Silverlight), IPsec, IxLoad- Attack and IxLoad-AppLibrary. Includes EPC and Wi-Fi Offload protocols. Enables 10 Gig throughput per unit</p>

Learn more at: [www.keysight.com](http://www.keysight.com)

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