

# IxNetwork Virtual Edition (VE)

## Virtualized Network Performance Testing

### Problem: The Many Unknowns of Virtualizing Networks, Services, and Functions

Cloud computing and Network Functions Virtualization (NFV) are creating a new paradigm of user experience. Users expect immediate access to a wide range of media-rich applications and services, instantly, from any location. Integrating virtualization across servers within a data center is key to creating an adaptable cloud network. Service providers are looking to accelerate the deployment of these new services, while reducing capital and operating expenses, and integrating NFV into their network. These new services require thorough testing to ensure functionality, performance, security, and reliability of the applications and devices, as well as the new infrastructure, to ensure it can deliver the touted advantages.

### Solution: Reliable Testing of Network Migration from Physical to Virtual

IxNetwork VE is designed to test physical and virtual network infrastructures and devices, with the ability to validate conformance, functionality, performance, scalability, and convergence by using scaled protocol emulation and powerful traffic generation. IxNetwork VE can emulate protocols for routing and switching, data center ethernet, software-defined networking (SDN), broadband access, and industrial ethernet. It provides a flexible traffic generation and analysis solution to validate physical and virtual devices and networks at scale in 1 Gbps, 10 Gbps, and 100 Gbps increments. For data center / cloud computing environments, IxNetwork VE can benchmark the performance of virtualized servers

### Highlights

- Test the most critical components of virtual and physical network devices, including conformance, functionality, performance, and scalability.
- Accelerate the time to market by conducting tests earlier in the development lifecycle. Automate the tests to be re-used across the virtual or hardware versions of IxNetwork.
- Identify and isolate data center configuration and performance issues by using flexible test tool deployment, which can be easily moved, changed, or scaled up / down.
- Assess how virtual machine mobility impacts application reliability and scalability. Run the tests during live migration to ensure minimum network downtime.
- Validate next generation 5G / NFV networks by testing within Private Clouds / Telco Clouds powered by OpenStack or VMware vCenter orchestration.
- Understand how network applications are affected by deployment within different Public Clouds such as Amazon AWS, Google Cloud, or Microsoft Azure.
- Leverage subscription-based licensing that enables the flexibility of pay-as-you-grow OpEx model.

# IxNetwork

**VE**

 **KEYSIGHT**  
TECHNOLOGIES

by simulating data center traffic between virtual machines. It enables the ability to deploy virtual test ports inside virtualized network devices, for end-to-end testing of NFV implementations.

The IxNetwork VE subscription model is aligned with enterprise project-based IT OpEx funding requirements. Acquire the tools quickly, scale up and scale down as project needs demand, and deploy anywhere with virtualization speed and simplicity.

Visit [keysight.com](http://keysight.com) for more information on the IxNetwork VE product.

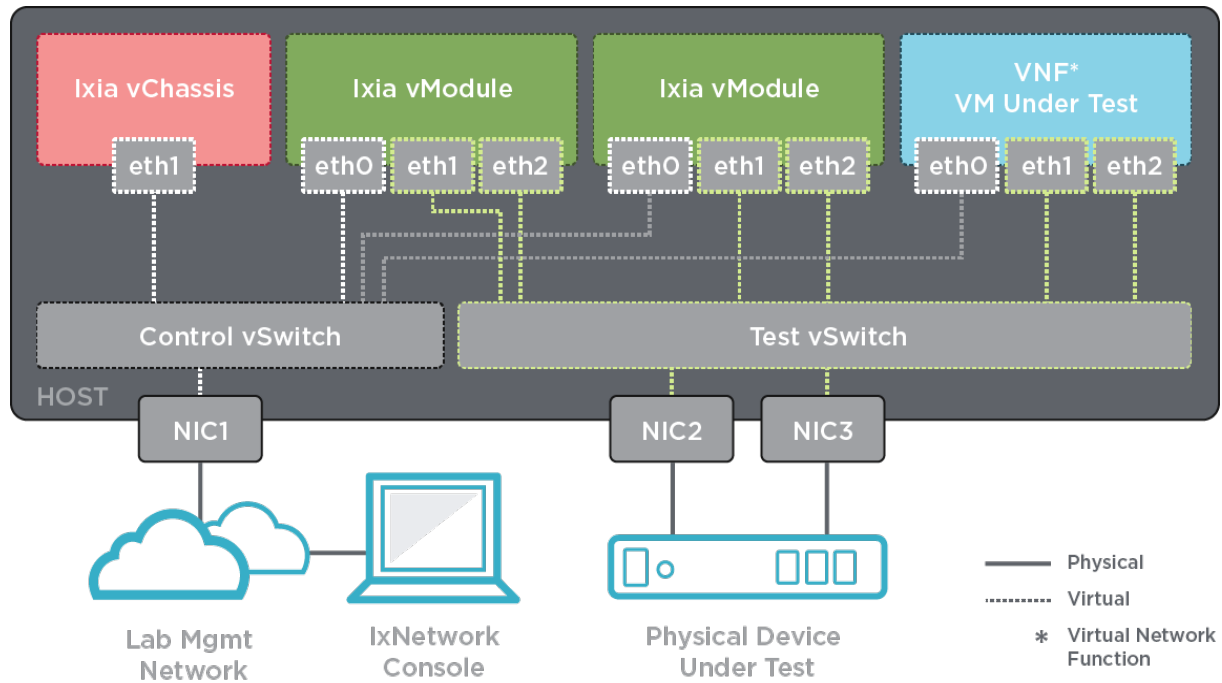


Figure 1 IxNetwork VE deployment for both virtual and physical device testing

## Key Features

- Provides comprehensive protocol coverage across a large set of networking technologies.
- Includes Routing, Switching, MPLS, Broadband Access, Data Center Networking, and SDN.
- Powerful traffic generation capabilities with DPDK Performance Acceleration for L23 Traffic.
- Hundreds of application traffic flows for Stateful L47 Traffic enabled by the AppLibrary engine.
- Powerful statistics engine with high level aggregated views as well as detailed drilldown views.
- Common IxNetwork user interface and experience across both Hardware / Virtual products.
- Easy transition between Hardware / Virtual platforms through common configurations and scripts.
- Enables end-to-end testing from a single pane of glass across virtual and physical environments.
- Comprehensive hypervisor support for standalone hypervisors such as VMware ESXi and KVM.
- Comprehensive orchestration support in Private Clouds based on VMware vCenter / OpenStack.
- Comprehensive support for Public Clouds inside Amazon AWS / Google Cloud / Microsoft Azure.
- Includes Virtual Machines with Virtual Chassis / Virtual Load Module / Virtual Test Appliance roles.
- Provides software optimized for protocol emulation and traffic generation in virtual environments.

- Flexible all-inclusive subscription licensing model reduces startup cost and enables easier growth.
- Common License Server shared among IxLoad VE, IxNetwork VE, BreakingPoint VE, and others.
- Full automation capabilities with REST, TCL, Perl, Python, and Ruby API support.

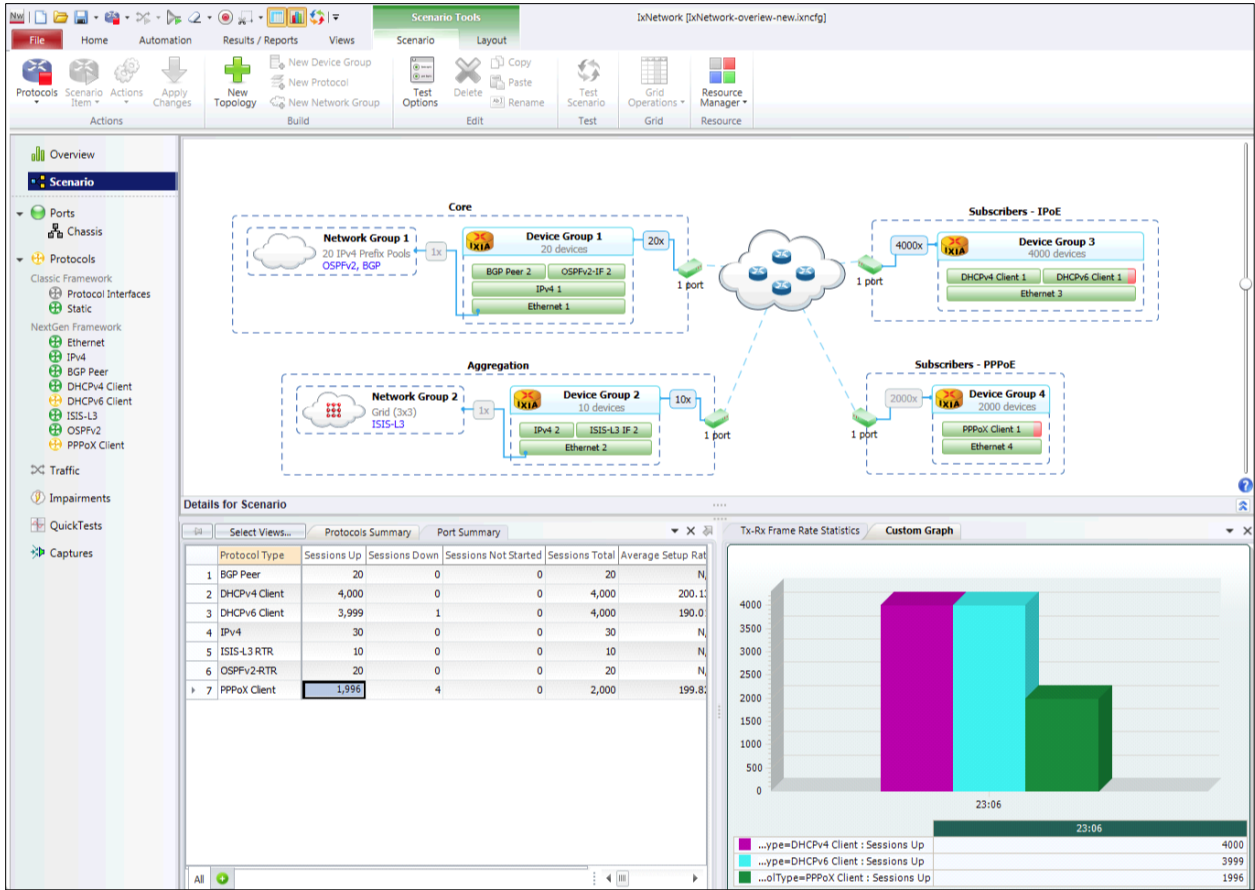


Figure 2 IxNetwork real-world network topology viewer with per-session protocol drill-down

## Specifications

IxNetwork VE features, functions, and capacities for the Virtual Chassis, Virtual Load Modules, and Virtual Test Appliance:

Feature	Virtual Chassis	Virtual Load Module	Virtual Test Appliance
Maximum # of Virtual Ports	128	32 *	8
Maximum # of Virtual Load Modules	32	N / A	1
Maximum # of Simultaneous Users	32	1	1
Guest OS	Based on CentOS 7.9 / 64-bit / Linux 3.10 Custom Kernel		
vCPU	2 vCPUs	4 vCPUs *	4 vCPUs *
Memory	4 GB RAM	4 GB RAM *	4 GB RAM *
Disk	8 GB	2 GB	8 GB
<p>* A note on resource allocation when DPDK Performance Acceleration is enabled. In this mode a maximum of 8x Virtual Ports can be used per Virtual Load Module / Virtual Test Appliance. For optimal performance we recommend that you allocate 2 vCPU / 2 GB RAM for management functions and additional 2 vCPU / 0.5 GB RAM for each Virtual Port. The minimum resources are 4 vCPU / 4 GB RAM. The recommended values for various numbers of Virtual Ports are as follows:</p> <ul style="list-style-type: none"> <li>• <b>1x vPort:</b> 2 vCPU / 2 GB RAM (Management) + 1 x 2 vCPU / 0.5 GB RAM (Test) = <b>4 vCPU / 4 GB RAM</b></li> <li>• <b>2x vPort:</b> 2 vCPU / 2 GB RAM (Management) + 2 x 2 vCPU / 0.5 GB RAM (Test) = <b>6 vCPU / 4 GB RAM</b></li> <li>• <b>4x vPort:</b> 2 vCPU / 2 GB RAM (Management) + 4 x 2 vCPU / 0.5 GB RAM (Test) = <b>10 vCPU / 4 GB RAM</b></li> <li>• <b>8x vPort:</b> 2 vCPU / 2 GB RAM (Management) + 8 x 2 vCPU / 0.5 GB RAM (Test) = <b>18 vCPU / 6 GB RAM</b></li> </ul>			
Login via Web UI	admin / admin	N / A	admin / admin
Login via SSH	admin / admin	admin / admin	admin / admin
IxNetwork Web UI	Yes (optional) **	N / A	N / A
<p>** A note on resource allocation when installing IxNetwork Web UI on the Virtual Chassis. In this mode the Virtual Chassis must be provisioned with at least 4 vCPU / 8 GB RAM / 16 GB HDD before starting the IxNetwork Web UI installation. The IxNetwork Web UI component is automatically allocated half the vCPU / RAM resources which were provisioned at installation time (at least 2 vCPU / 4 GB RAM). The resource allocation for the IxNetwork Web UI cannot be modified at a later point even if the overall resource allocation for the entire Virtual Chassis instance is changed.</p>			

IxNetwork VE distribution and packaging format for **Private Cloud** platforms with **Manual Deployment Scenario** (by using the platform specific tools for deploying the Virtual Edition products):

Platform	Virtual Chassis	Virtual Load Module	Virtual Test Appliance	Virtual Windows Client
VMware ESXi	OVA	OVA	OVA	N / A
VMware vCenter	OVA	OVA	OVA	N / A
KVM / stand-alone	QCOW2	QCOW2	QCOW2	N / A
KVM / OpenStack	QCOW2	QCOW2	QCOW2	N / A
Microsoft Hyper-V	N / A	N / A	N / A	N / A
Docker Containers	N / A	N / A	N / A	N / A

IxNetwork VE distribution and packaging format for **Private Cloud** platforms with **Automatic Deployment Scenario** (by using Deployment Wizard for creating large scale deployments with ease):

Platform	Virtual Chassis	Virtual Load Module	Virtual Test Appliance	Virtual Windows Client
VMware ESXi	SH	SH	N / A	N / A
VMware vCenter	OVA	OVA	N / A	N / A
KVM / stand-alone	SH	SH	N / A	N / A
KVM / OpenStack	N / A	N / A	N / A	N / A
Microsoft Hyper-V	N / A	N / A	N / A	N / A
Docker Containers	N / A	N / A	N / A	N / A

IxNetwork VE distribution and packaging format for **Public Cloud** platforms with **Cloud Deployment Scenario** (by using the platform specific tools for deploying the Virtual Edition products):

Platform	Virtual Chassis	Virtual Load Module	Virtual Test Appliance	Virtual Windows Client
Amazon AWS	N / A	N / A	AMI	AMI
Google Cloud	N / A	N / A	QCOW2	QCOW2
Microsoft Azure	N / A	N / A	VHD	VHD

## Qualified and Compatible Environments

IxNetwork VE is designed to work best when used in a qualified environment. Our recommendation is to always use one of the qualified versions of the virtualization platforms.

IxNetwork VE is also compatible with different other environments. In case there are issues encountered in these environments, Keysight will make reasonable efforts to address them, but cannot guarantee specific outcomes or results. In such rare cases, the proposed solution is to use a qualified environment.

Category		Qualified		Compatible	
<b>Hypervisor and Host OS</b>		VMware vSphere ESXi 6.X VMware vSphere ESXi 7.X  KVM over CentOS 7.X KVM over CentOS 8.X KVM over Ubuntu 18.04 LTS KVM over Ubuntu 20.04 LTS		KVM over RHEL 7.X KVM over RHEL 8.X KVM over Ubuntu 14.04 LTS KVM over Ubuntu 16.04 LTS	
<b>Management and Orchestration</b>		VMware vCenter 6.X VMware vCenter 7.X  OpenStack Wallaby (Vanilla distribution)		Other OpenStack-based platforms (Vanilla distribution)  Other OpenStack-based platforms (Vendor-specific distribution)	
<b>Public Cloud</b>		Amazon Web Services Marketplace Google Cloud Platform Microsoft Azure *		N / A	
<b>Network Connection and vNIC Driver</b>	<b>Virtual Switch</b>	VMware vSwitch	1G → 400G	vmxnet3	N / A
		KVM Linux Bridges	1G → 400G	virtio	
		KVM OVS	1G → 400G	virtio	
	<b>PCI-PT</b>	Intel 350	1G	igb ** ixgbe i40e ice mlx4 mlx5	Cisco VIC 1G / 10G enic **
		Intel 5xx	10G		
		Intel 7xx	10G / 25G / 40G		
		Intel 8xx	25G / 50G / 100G		
		Mellanox CX-3 / CX-4	10G / 25G / 40G		
		Mellanox CX-5 / CX-6	25G / 50G / 100G / 200G		
<b>SR-IOV</b>	Intel 350	1G	igbvf ** ixgbev iavf iavf mlx4 mlx5	Cisco VIC 1G / 10G enic **	
	Intel 5xx	10G			
	Intel 7xx	10G / 25G / 40G			
	Intel 8xx	25G / 50G / 100G			
	Mellanox CX-3 / CX-4	10G / 25G / 40G			
	Mellanox CX-5 / CX-6	25G / 50G / 100G / 200G			

Category	Qualified	Compatible
Virtual Switch Model	Virtual Standard Switch (on VMware) Virtual Distributed Switch (on VMware) Linux Bridges (on KVM) Open Virtual Switch (on KVM) Open Virtual Switch (on OpenStack)	Linux Bridges (on OpenStack)

\* DPDK Performance Acceleration not supported when running in Microsoft Azure Public Cloud.

\*\* DPDK Performance Acceleration not supported by Intel 1G / Cisco 10G NIC connected in PCI-PT / SR-IOV.

## Network Protocols

IxNetwork emulates a wide variety of networking protocols. By using the IxNetwork test application each Virtual Test Port is capable of emulating thousands of routers or bridges with millions of reachable networks and hosts. Users can easily scale the size of emulated topologies by adding additional Virtual Test Ports. Combined with traffic generation and measurement capabilities, the Virtual Load Modules / Virtual Test Appliances verify advertised topologies and networks for reachability and performance.

Technology	Protocols
<b>Interfaces</b>	MAC VLAN IPv4 (ARP / PING) IPv6 (NDP / SLAAC / PING)
<b>Routing / Switching</b>	BGP4 / BGP4+ EIGRP / EIGRPv6 ISISv4 / ISISv6 OSPFv2 / OSPFv3 PIM-SM / PIM-SSM RIP / RIPng BFD STP / RSTP / MSTP PVST+ / RPVST+ LACP / Link Aggregation LACP / Protocols (PoLACP)

Technology	Protocols
<b>Software Defined Network</b>	Segment Routing BGP Prefix SID Segment Routing ISIS Segment Routing OSPF Segment Routing v6 / G-SRv6 Segment Routing v6 / G-SRv6 OAM BGP FlowSpec BGP Link State (BGP-LS) BGP SR TE Policy BIER NETCONF OpenFlow OVSDB PCEP S-BFD GENEVE VXLAN VXLAN EVPN ISIS / OSPFv2 Flex-Algo gRIBI
<b>Others</b>	eCPRI ESMC NTP
<b>MPLS</b>	RSVP-TE P2P / RSVP-TE P2MP LDP / LDPv6 / mLDP L3 MPLS VPN / 6VPE / 6PE L2 LDP VPN / PWE / VPLS BGP VPLS / VPWS BGP RFC3107 EVPN / PBB-EVPN Multicast VPN Rosen Draft Multicast VPN NG MPLS OAM MPLS TP MPLS over GRE MPLS over UDP
<b>Broadband / Access / Authentication</b>	PPPoE / L2TPv2 DHCPv4 / DHCPv6 DHCPv4 / DHCPv6 over EoGRE IPv6 Autoconfiguration (SLAAC) Bonded GRE IGMP / MLD 802.1x ANCP



Technology	Protocols
<b>Industrial Ethernet</b>	CFM IEEE 802.1ag Link OAM IEEE 802.3ah Service OAM ITU-T Y.1731 PBT / PBB-TE E-LMI TWAMP
<b>Data Center Ethernet</b>	DCBX / LLDP FCoE / FIP FCoE Forwarder FabricPath SPBM TRILL
<b>Application Mixes</b>	Hundreds of AppLibrary flows inside Application Library – A continually expanding and updated library of pre-defined application flows and application mixes of the most current internet applications.

## Traffic Capabilities

IxNetwork VE supports traffic generation and measurement that ensures precision and performance. The sophisticated traffic generator is also tightly integrated with the Control Plane protocols.

Traffic Generator	Specification
<b>Configuration</b>	Advanced Traffic Wizard—step by step wizard traffic configuration Quick Flow Group—granular control of packet sequence and variations
<b>Scale</b>	Per Application—Up to 16,000 Flow Groups Per Application—Up to 4,000,000 trackable receive flows Per Virtual Port—Up to 256 Flow Groups Per Virtual Port—Up to 4,096 trackable receive flows
<b>Dynamic Controls</b>	Change frame rate and frame size on the fly
<b>Traffic Types</b>	IPv4, IPv6, MPLS multi-labels, Ethernet, VLAN, provider bridges (Q-in-Q), provider backbone bridges (MAC-in-MAC), PPP, L2 MPLS VPN, L3 MPLS VPN, VPLS, 6PE, 6VPE, multicast, multicast VPN
<b>Source / Destination Mapping</b>	One-to-one, many-to-many, fully meshed
<b>Routes Mapping</b>	One-to-one, fully meshed
<b>Flow Grouping</b>	Build flow groups based on packet content (such as QoS or VLAN ID)

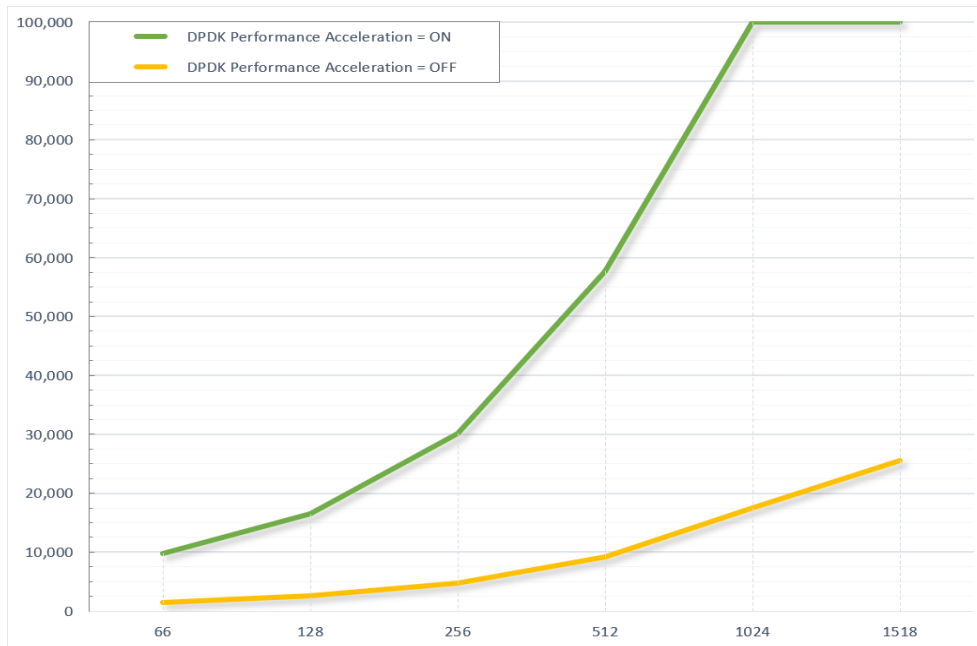
Traffic Generator	Specification
<b>Traffic Profile</b>	<ul style="list-style-type: none"> <li>• Frame Size: Fixed, Increment, Random, IMIX, Custom IMIX, Quad Gaussian Distribution, Auto</li> <li>• Rate: Percent Line Rate, Packets Per Second, Layer 2 Bit Rate (bps, Kbps, Mbps, Bps, KBps, MBps)</li> <li>• Payload Pattern: Increment Byte, Increment Word, Decrement Byte, Decrement Word, Random, Custom</li> <li>• QoS: TOS, DSCP, IPv6 Traffic Classes, 802.1p, MPLS EXP</li> </ul>
<b>Per-Flow Traffic Tracking</b>	Single or multi-field tracking of any field, including QoS (TOS / DSCP), VLAN, source MAC address, destination MAC address, source IP address, destination IP address, MPLS label, MPLS flow descriptor, streams, Source / Destination IP pair, Source / Destination MAC pair, custom packet tracking
<b>Real-Time Flow Filtering Flow Detective</b>	Real-time filtering of flows based on tracking settings with user-defined criteria. Single out best / worst performing flows based on Rx count, min / max / average latency, timestamp, real-time packet loss by using sequence, identify dead flows
<b>Flow Control</b>	N / A
<b>Packet Editor</b>	<ul style="list-style-type: none"> <li>• Edit Headers: Single Value, Increment, Decrement, List, Random</li> <li>• Set Meshing: Default, Link / Unlink with other headers, Fully Mesh</li> <li>• Add Tracking: Track user defined traffic flows based on any header</li> </ul>

Measurement	Specification
<b>Loss</b>	Tx Frames Rx Expected Frames Rx Frames Rx Bytes Frame Delta Loss %
<b>Rate</b>	Tx Frame Rate Rx Frame Rate Tx Rate (Bps, bps, Kbps, Mbps) Rx Rate (Bps, bps, Kbps, Mbps) Tx L1 Rate (bps) Rx L1 Rate (bps)
<b>Latency (based on NTP)</b>	Min Latency Avg Latency Max Latency
<b>Basic Sequence Checking</b>	Small Error Big Error Reverse Error Duplicate Frames Sequence Gaps Last Sequence Number
<b>Advanced Sequence Checking</b>	Lost Frames In Order Frames Reordered Frames Duplicate Frames Late Frames Last Sequence Number
<b>Time Stamps</b>	First Timestamp Last Timestamp
<b>Packet Loss Duration</b>	Estimated time without received packets calculated based on Frames Delta and expected Rx Rate

## Traffic Performance

IxNetwork VE implements DPDK Performance Acceleration for the L23 Stateless Traffic Engine. Using the DPDK Traffic Engine results in increased Data Plane performance which is required to validate the latest generation Virtual Network Functions. The traffic throughput is increased by a factor of 5x thanks to the DPDK Performance Acceleration.

Frame Size	DPDK Performance Acceleration = OFF		DPDK Performance Acceleration = ON	
	Bytes	MPPS	L1 Rate MBPS	MPPS
64	2.49	1,672	14.19	9,760
128	2.46	2,914	13.89	16,443
256	2.23	4,932	13.66	30,155
512	2.22	9,460	13.55	57,673
1,024	2.21	18,475	11.97	99,982
1,518	2.20	27,082	8.12	99,945



The performance numbers were benchmarked on a hardware platform composed of Dell R6525 / 2x AMD EPYC 7302 CPU @ 3.00 GHz / 128 GB RAM / Mellanox ConnectX-5 2x 100G NIC / PCI Express 4.0 with SR-IOV NIC connection and KVM / Ubuntu 20.04 LTS hypervisor. The traffic profile has one unidirectional IPv4 flow between 1x TX VM / 1x RX VM. Total resources required across 1x Virtual Chassis (2 vCPU / 4 GB RAM) and 2x Virtual Load Modules (4 vCPU / 4 GB RAM each) add up to 10 vCPU / 12 GB RAM.

## Test Results—Statistics Viewer

The IxNetwork statistics viewer is a powerful tool for viewing and analyzing real-time results and generating test reports.

- Aggregate statistics are shown hierarchically, with the ability to drill down to group-level and flow-level statistics
- Different modes to view traffic statistics—Instantaneous, Cumulative, or both
- CSV files can be used to capture a single results view, or at the global level, to capture all results in real-time; an integrated CSV viewer is provided to view large-result files

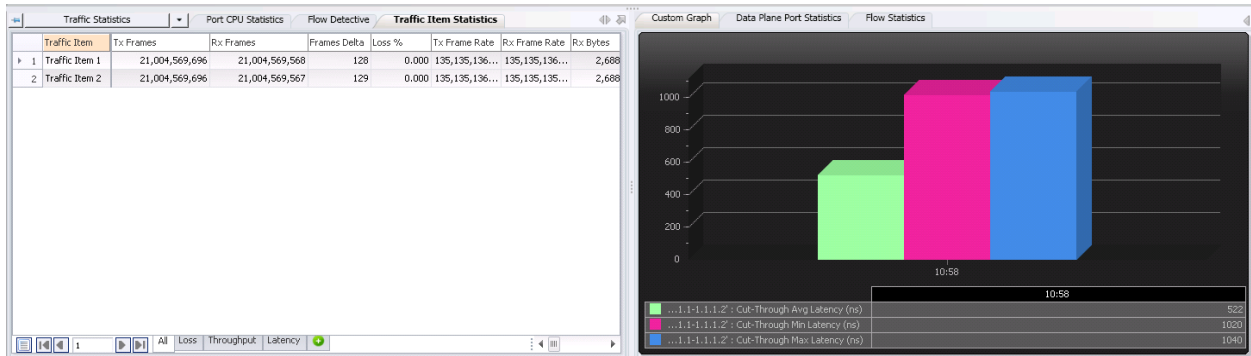


Figure 3 Statistics Viewer

Function	Statistics
Global Protocol	Port-level protocol counters
Port	Port mode, speed, frame and data rate, OAM statistics
Tx-Rx Frame Rate	Tx-Rx frame rate graph
Port CPU	Port CPU utilization and statistics
Data Plane Port	Port-based frame counts and rate excluding control-plane traffic
Traffic Item	Statistics provide an aggregate of all the flows in the Traffic Item
User Defined	User-defined view is used for drill-down to user-defined tracking options
Flow Statistics	Flow-level measurements
Flow Detective	Filtering and sorting based results

## Resource Manager

Often expertise for different protocols lies within different members of a testing team. A common pain-point for our customers was the lack of a collaboration tool to aid them in incrementally building configurations. With the Resource Manager, users can now piece-meal their configurations together. The Resource Manager allows users to save different pieces of their configurations, like protocols and traffic elements, and then build a configuration by re-using saved elements in their current configuration.

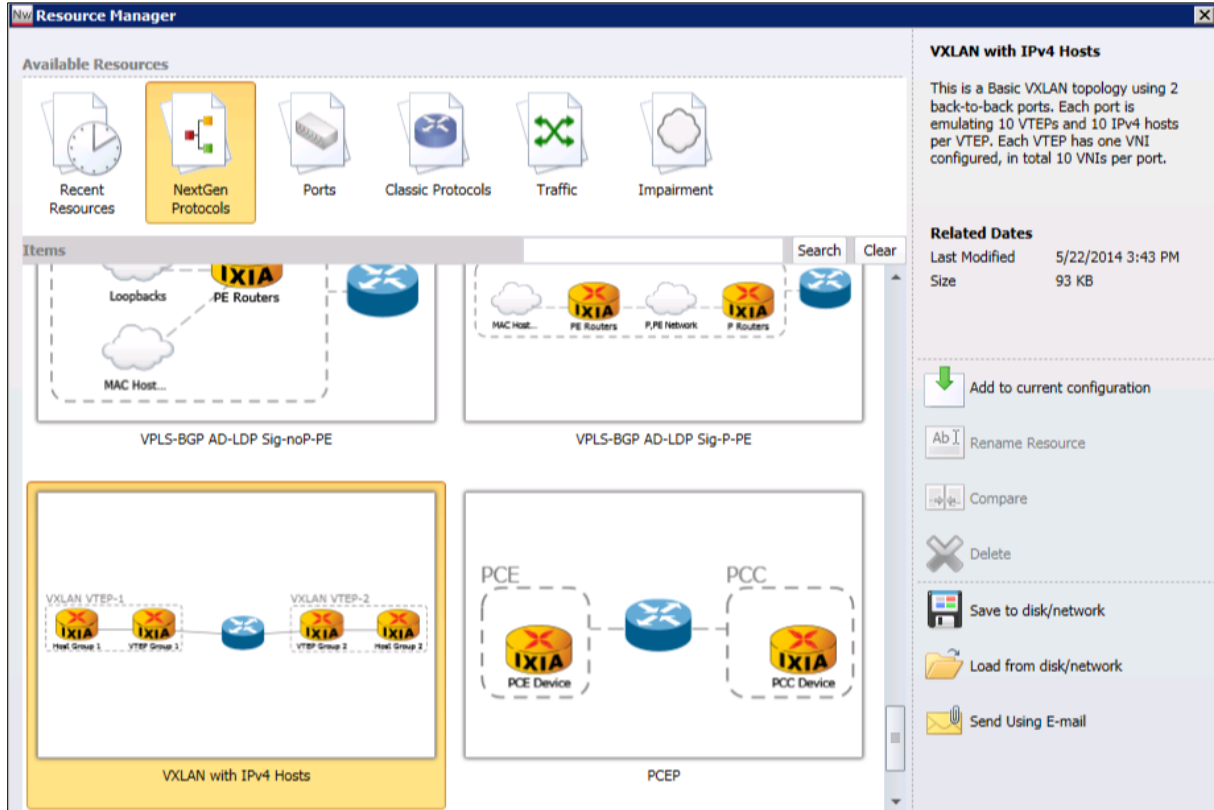


Figure 4 Resource Manager

It also allows users to clearly see changes made to their resources/configurations by using a 'diff' functionality within the application. Using the Resource Manager is a powerful way to collaborate and quickly build expertise with a team.

## Reports

Building a test-results report requires test data. IxReporter introduces a new database, referred to in the application as an 'object model.' The object model is populated by a testing application (like IxNetwork) with the test configuration parameters and the test results. All of these 'objects' can be included in a report, usually in a table or chart. With this powerful concept, tables and charts can be created that combine statistics and configuration information as well as have multiple protocols.

## Built-in Data Capture and Analysis

Internet protocols are complex and multi-protocol emulations even more so. IxNetwork includes a built-in tool that captures the control-plane traffic along with data-plane traffic, merging both into a single capture file. IxNetwork allows you to trigger and filter control-plane and data-plane packet captures based on user-defined packet fields.

## Automation

IxNetwork provides powerful GUI-based automation with the Test Composer and QuickTests. It also has a robust feature set for GUI-to-script and API-based automation. The IxNetwork automation is simplicity at its best. Test scenarios are set up by using the IxNetwork step-by-step GUI, and then a single button-press generates a TCL test script. Scripts may be modified and combined in any fashion. When the script is run, the IxNetwork GUI watches the execution and provides real-time statistics and state information.

Types	Test Requirement	Detail
<b>QuickTest</b>	Scalability	<ul style="list-style-type: none"><li>Standards-based IETF RFC test methodologies, as well as a custom mode for user-defined performance tests</li><li>Easy-to-use, configurable, pre-packaged tests</li><li>Generate detailed reports of results</li></ul>
<b>Macro Recorder</b>	Functionality	<ul style="list-style-type: none"><li>'Click-thru automation' means no more scripting</li><li>Rapid capture of manual test cases</li><li>Capture steps that cause a failure for reproducibility</li></ul>
<b>Test Composer and Tweakables</b>	Regression	<ul style="list-style-type: none"><li>GUI-based solution to automate test actions</li><li>Detailed control over test execution without TCL expertise</li><li>Complete access to the TCL API with easy UI</li><li>Edit Macro Recorded steps for customization of GUI captured events</li></ul>
<b>ScriptGen</b>	Regression	Provides an easy, one-click GUI-to-script generation
<b>Low-Level and High-Level APIs</b>	Functionality and regression	<ul style="list-style-type: none"><li>For TCL scripting experts</li><li>One-click GUI to TCL script conversion available (ScriptGen)</li></ul>

Types	Test Requirement	Detail
		<ul style="list-style-type: none"> <li>• Complete access to and control over test configuration</li> <li>• REST, TCL, Perl, Python, and Ruby API support</li> </ul>

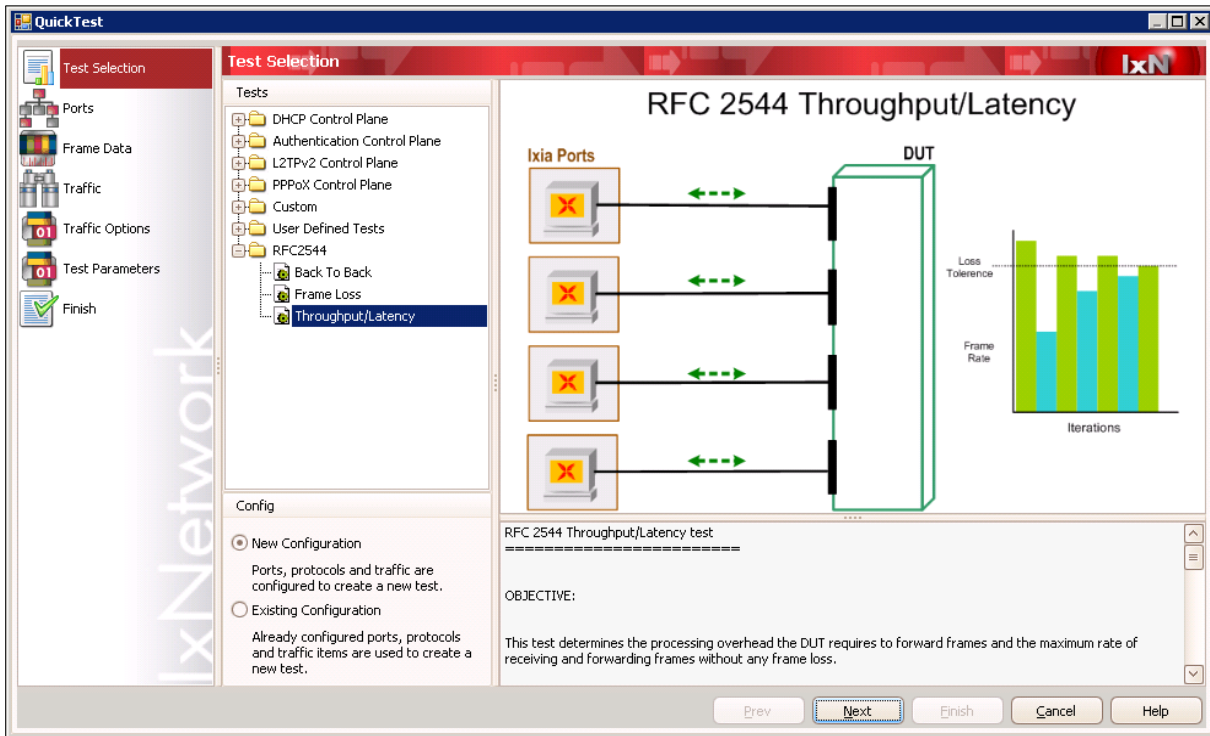


Figure 5 QuickTest end-to-end wizards

QuickTest	Tests
<b>RFC 2544 Tests</b>	Throughput and latency, frame loss, back-to-back
<b>RFC 2889 Tests</b>	Broadcast Rate, Congestion Control, Frame Error Filtering, Fully Meshed, Many to One, One to Many, Partially Meshed
<b>RFC 3918 Tests</b>	Aggregated Multicast Throughput, Burdened Group Join Delay, Burdened Multicast Latency, Forwarding Latency, Group Join/Leave delay, Mixed Class throughput, Multicast Group Capacity, Multicast Group Pattern Verification, Scaled Group Forwarding
<b>ITU-T Y.1564 Service Activation</b>	Service Configuration, Service Performance
<b>Asymmetric Data Performance</b>	Throughput / Latency, Frame Loss



QuickTest	Tests
Control Plane Tests	Session setup rate, session capacity
Converged Data Center	Cloud Performance
OpenFlow	Failover Performance, L2 Address Learning, L3 Address Learning, Switch Flow Table Capacity
Custom Tests	Continuous, fixed duration run, incremental, throughput (binary search)
User-Defined Tests	Tests defined in Test Composer

## Technology Solutions

Visit [keysight.com](http://keysight.com) for More Information on IxNetwork and Keysight Virtualization Solutions

- IxNetwork Overview—L23 Network Infrastructure Performance Testing
- IxNetwork Virtual Edition (VE)—Virtualized Network Performance Testing
- IxNetwork Industrial Ethernet Test Solution
- IxNetwork Routing and Switching Test Solution
- IxNetwork Broadband Test Solution
- IxNetwork Data Center Ethernet Test Solution
- IxNetwork MPLS Test Solution
- IxLoad Virtual Edition (VE)—Virtualized Multiplay Services Testing
- BreakingPoint Virtual Edition (VE)—Virtualized Application and Security Testing
- Cloud Peak—Virtualized Infrastructure Benchmarking

## Ordering Information

939-9510

**IXIA IxNetwork VE Tier-0 1G Subscription License.** Includes the IPv4 / IPv6 interfaces in IxNetwork VE for the purchased term. Supports no Control Plane and up to 1 Gbps throughput per unit.

939-9501

**IXIA IxNetwork VE Tier-1 1G Subscription License.** Includes all protocols supported in IxNetwork VE for the purchased term. Supports low scale Control Plane and 1 Gbps throughput per unit.

939-9502

**IXIA IxNetwork VE Tier-2 1G Subscription License.** Includes all protocols supported in IxNetwork VE and all IxNetwork QuickTests for the purchased term. Supports medium scale Control Plane and 1 Gbps throughput per unit.

939-9503

**IXIA IxNetwork VE Tier-3 1G Subscription License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 1 Gbps throughput per unit.

939-9509

**IXIA IxNetwork VE Tier-3 1G Perpetual License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 1 Gbps throughput per unit.

939-9523

**IXIA IxNetwork VE Tier-3 10G Subscription License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 10 Gbps throughput per unit.

939-9529

**IXIA IxNetwork VE Tier-3 10G Perpetual License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 10 Gbps throughput per unit.

939-9620

**IXIA IxNetwork VE Tier-0 100G Subscription License.** Includes the IPv4 / IPv6 interfaces in IxNetwork VE for the purchased term. Supports no Control Plane and up to 100 Gbps throughput per unit.

### 939-9621

**IXIA IxNetwork VE Tier-1 100G Subscription License.** Includes all protocols supported in IxNetwork VE for the purchased term. Supports low scale Control Plane and 100 Gbps throughput per unit.

### 939-9622

**IXIA IxNetwork VE Tier-2 100G Subscription License.** Includes all protocols supported in IxNetwork VE and all IxNetwork QuickTests for the purchased term. Supports medium scale Control Plane and 100 Gbps throughput per unit.

### 939-9623

**IXIA IxNetwork VE Tier-3 100G Subscription License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 100 Gbps throughput per unit.

### 939-9626

**IXIA IxNetwork VE Tier-0 100G Perpetual License.** Includes the IPv4 / IPv6 interfaces in IxNetwork VE for the purchased term. Supports no Control Plane and up to 100 Gbps throughput per unit.

### 939-9627

**IXIA IxNetwork VE Tier-1 100G Perpetual License.** Includes all protocols supported in IxNetwork VE for the purchased term. Supports low scale Control Plane and 100 Gbps throughput per unit.

### 939-9628

**IXIA IxNetwork VE Tier-2 100G Perpetual License.** Includes all protocols supported in IxNetwork VE and all IxNetwork QuickTests for the purchased term. Supports medium scale Control Plane and 100 Gbps throughput per unit.

### 939-9629

**IXIA IxNetwork VE Tier-3 100G Perpetual License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 100 Gbps throughput per unit.

### 939-4008-T

**IXIA TAA Compliant IxNetwork VE Tier-0 1G Subscription License.** Includes the IPv4 / IPv6 interfaces in IxNetwork VE for the purchased term. Supports no Control Plane and up to 1 Gbps throughput per unit.

### 939-4004-T

**IXIA TAA Compliant IxNetwork VE Tier-3 1G Subscription License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 1 Gbps throughput per unit.

### 939-4005-T

**IXIA TAA Compliant IxNetwork VE Tier-3 1G Perpetual License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 1 Gbps throughput per unit.

### 939-4006-T

**IXIA TAA Compliant IxNetwork VE Tier-3 10G Subscription License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 10 Gbps throughput per unit.

### 939-4007-T

**IXIA TAA Compliant IxNetwork VE Tier-3 10G Perpetual License.** Includes all protocols supported in IxNetwork VE, all IxNetwork QuickTests, IxNetwork-FT, and AppLibrary for the purchased term. Supports high scale Control Plane and 10 Gbps throughput per unit.

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

For more information on Keysight Technologies' products, applications, or services, please contact your local Keysight office. The complete list is available at: [www.keysight.com/find/contactus](http://www.keysight.com/find/contactus)

