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 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 www.keysight.com for more information on the IxNetwork VE product.

KEYSIGHT

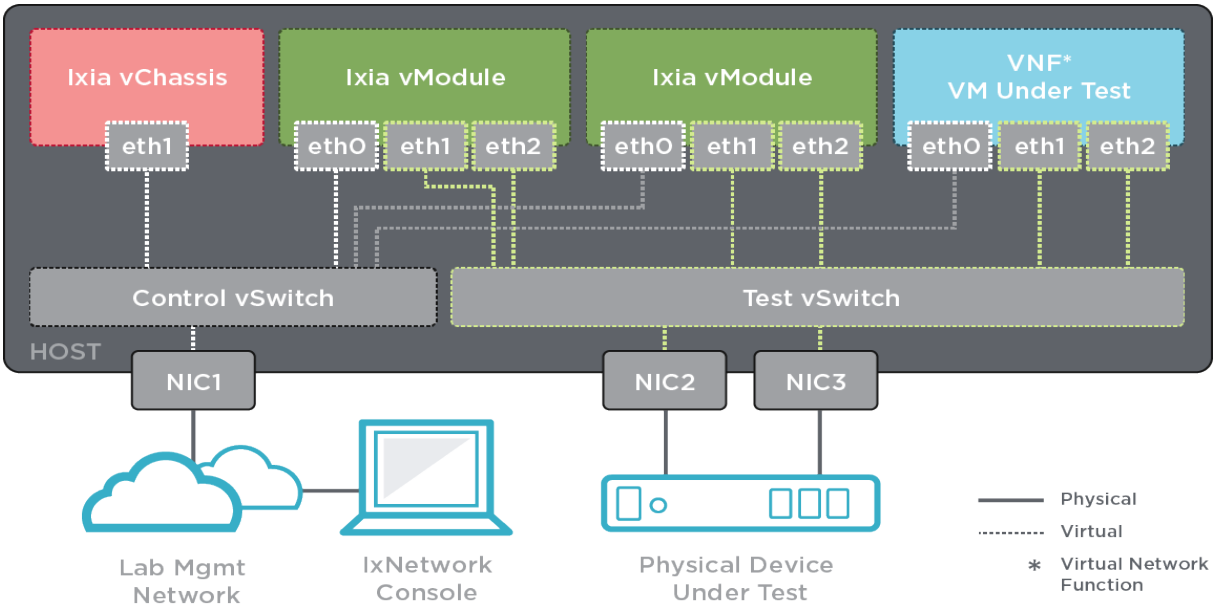


Figure 1. IxNetwork VE deployment for both virtual and physical device testing

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, Microsoft Azure, or Oracle Cloud.
- Leverage subscription-based licensing that enables the flexibility of pay-as-you-grow OpEx model with different feature tiers available in multiple performance levels (such as 1G / 10G / 100G).



Table of Contents

Key Features 4

Specifications 5

Qualified and Compatible Environments 7

Network Protocols 10

Traffic Capabilities 12

Traffic Performance 14

Test Results — Statistics Viewer 15

Resource Manager 16

Reports 17

Built-in Data Capture and Analysis 17

Automation 17

Technology Solutions 19

Ordering Information 19

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 stand-alone platforms like VMware ESXi / KVM / Hyper-V.
- 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 separated Chassis / Load Module or all-in-one Test Appliance roles.
- Provides software optimized for protocol emulation and traffic generation in virtualized environments.
- Flexible all-inclusive subscription licensing model reduces startup cost and enables easier growth.
- Common License Server is shared among IxLoad VE, IxNetwork VE, BreakingPoint VE, and others.
- Full automation capabilities with REST, TCL, Perl, Python, and Ruby API support.

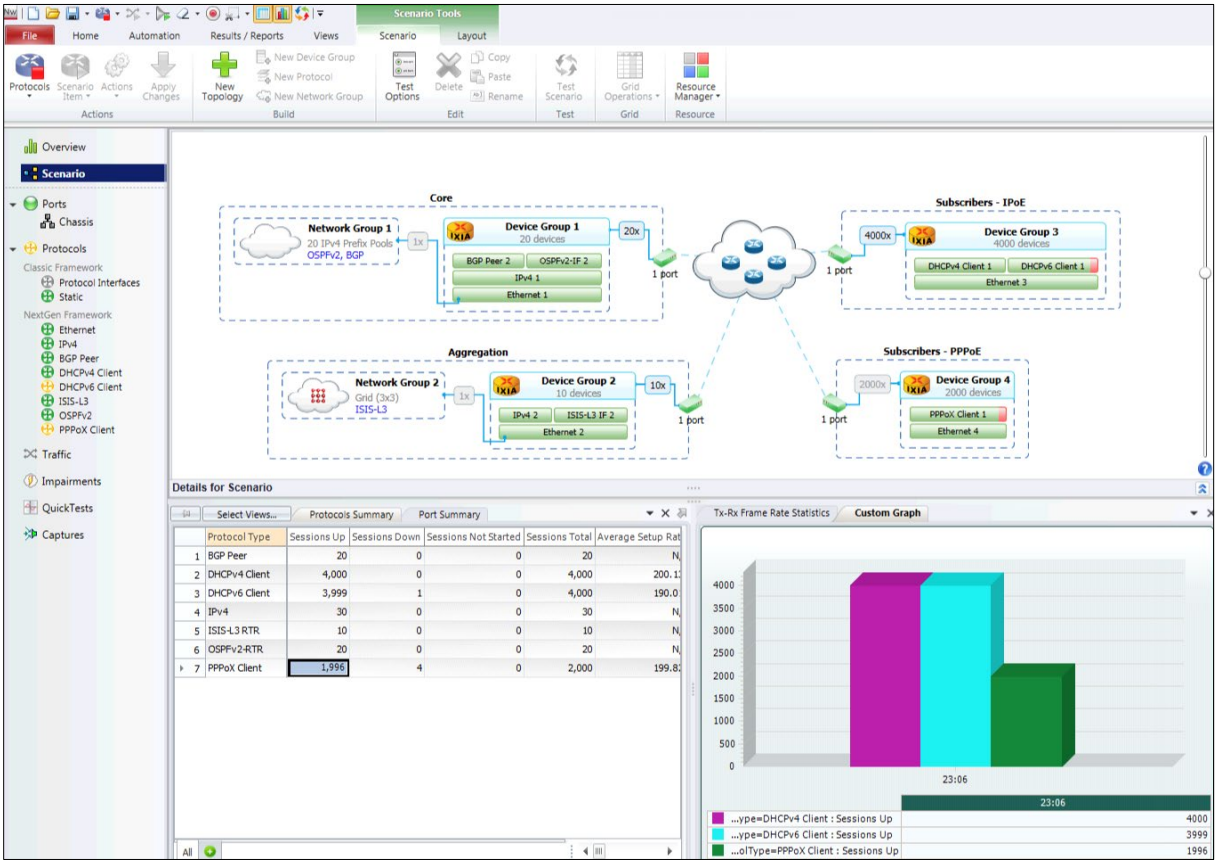


Figure 2. IxNetwork real-world network topology viewer with per-session protocol drill-down

Specifications – Virtual Architecture

The traditional Virtual Architecture is based on a customized Linux 3.10 kernel and supports the most comprehensive set of capabilities. The following table highlights the 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 Debian 12 (Bookworm) / x86 64-bit		
Guest Kernel	Linux 6.1.0 Stock	Linux 3.10 Custom	Linux 3.10 Custom
vCPU	2 vCPU – Minimum 2 vCPU – Default 512 vCPU – Maximum	2 vCPU – Minimum 4 vCPU – Default * 16 vCPU – Maximum	2 vCPU – Minimum 4 vCPU – Default * 16 vCPU – Maximum
Memory	4 GB RAM	4 GB RAM *	4 GB RAM *
Disk	8 GB	4 GB	8 GB
Management IPv4	Yes	Yes	Yes
Management IPv6	N / A	N / A	Yes
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

* A note on resource allocation when DPDK Performance Acceleration is enabled for **Virtual Ports.** 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 an 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:

- **1x vPort:** [2 vCPU / 2 GB RAM] (Management) + 1 x [2 vCPU / 0.5 GB RAM] (Test) => [**4 vCPU / 4 GB RAM**]
- **2x vPort:** [2 vCPU / 2 GB RAM] (Management) + 2 x [2 vCPU / 0.5 GB RAM] (Test) => [**6 vCPU / 4 GB RAM**]
- **4x vPort:** [2 vCPU / 2 GB RAM] (Management) + 4 x [2 vCPU / 0.5 GB RAM] (Test) => [**10 vCPU / 4 GB RAM**]
- **6x vPort:** [2 vCPU / 2 GB RAM] (Management) + 6 x [2 vCPU / 0.5 GB RAM] (Test) => [**14 vCPU / 5 GB RAM**]
- **8x vPort:** [2 vCPU / 2 GB RAM] (Management) + 8 x [2 vCPU / 0.5 GB RAM] (Test) => [**18 vCPU / 6 GB RAM**]

** 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 2 vCPU / 4 GB RAM. The resource allocation for the IxNetwork Web UI cannot be modified even if the overall resource allocation for the entire Virtual Chassis instance is changed.

Specifications – Cloud Architecture

The modern Cloud Architecture is based on a stock Linux 6.1 kernel and supports few protocol features and high speed interfaces for specific scenarios. The following table highlights the IxNetwork VE features, functions, and capacities for the Cloud Chassis, Cloud Load Modules, and Cloud Test Appliance:

Feature	Cloud Chassis	Cloud Load Module	Cloud Test Appliance
Maximum # of Cloud Ports	128	8	8
Maximum # of Cloud Load Modules	32	N / A	1
Maximum # of Simultaneous Users	32	1	1
Guest OS	Based on Debian 12 (Bookworm) / x86 64-bit		
Guest Kernel	Linux 6.1.0 Stock	Linux 6.1.0 Stock	Linux 6.1.0 Stock
vCPU	2 vCPU – Minimum 2 vCPU – Default 512 vCPU – Maximum	4 vCPU – Minimum 4 vCPU – Default * 512 vCPU – Maximum	4 vCPU – Minimum 4 vCPU – Default * 512 vCPU – Maximum
Memory	4 GB RAM	8 GB RAM *	8 GB RAM *
Disk	8 GB	4 GB	8 GB
Management IPv4	Yes	Yes	Yes
Management IPv6	N / A	N / A	Yes
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	Yes (optional) **

* A note on resource allocation when DPDK Performance Acceleration is enabled for **Cloud Ports.** In this mode a maximum of 8x Cloud Ports can be used per Cloud Load Module / Cloud Test Appliance. For optimal performance we recommend that you allocate [2 vCPU / 2 GB RAM] for management functions and an additional [2 vCPU / 1.0 GB RAM] for each Cloud Port. The minimum resources are [4 vCPU / 8 GB RAM]. The recommended values for various numbers of Cloud Ports are as follows:

- **1x cPort:** [2 vCPU / 2 GB RAM] (Management) + 1 x [2 vCPU / 1.0 GB RAM] (Test) => [**4 vCPU / 8 GB RAM**]
- **2x cPort:** [2 vCPU / 2 GB RAM] (Management) + 2 x [2 vCPU / 1.0 GB RAM] (Test) => [**6 vCPU / 8 GB RAM**]
- **4x cPort:** [2 vCPU / 2 GB RAM] (Management) + 4 x [2 vCPU / 1.0 GB RAM] (Test) => [**10 vCPU / 8 GB RAM**]
- **6x cPort:** [2 vCPU / 2 GB RAM] (Management) + 6 x [2 vCPU / 1.0 GB RAM] (Test) => [**14 vCPU / 8 GB RAM**]
- **8x cPort:** [2 vCPU / 2 GB RAM] (Management) + 8 x [2 vCPU / 1.0 GB RAM] (Test) => [**18 vCPU / 10 GB RAM**]

** A note on resource allocation when installing IxNetwork Web UI on the Cloud Chassis / Cloud Test Appliance. In this mode, the Cloud Chassis must be provisioned with at least 4 vCPU / 8 GB RAM / 16 GB HDD and the Cloud Test Appliance must be provisioned with at least 6 vCPU / 12 GB RAM / 16 GB HDD before starting the IxNetwork Web UI installation. The IxNetwork Web UI component is automatically allocated 2 vCPU / 4 GB RAM. The resource allocation for the IxNetwork Web UI cannot be modified even if the overall resource allocation for the entire Cloud Chassis / Cloud Test Appliance instance is changed.

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

Platform	Chassis	Load Module	Test Appliance	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	VHDX	VHDX	VHDX	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	Chassis	Load Module	Test Appliance	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	Chassis	Load Module	Test Appliance	Windows Client
Alibaba Cloud	N / A	N / A	N / A	N / A
Amazon AWS	N / A	N / A	Marketplace	Marketplace
Google Cloud	N / A	N / A	Marketplace	Marketplace
Microsoft Azure	N / A	N / A	Marketplace	Marketplace
Oracle Cloud	N / A	N / A	QCOW2	QCOW2

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
Hypervisor and Host OS		VMware vSphere ESXi 7.X VMware vSphere ESXi 8.X KVM over CentOS 7.X KVM over CentOS 8.X KVM over CentOS Stream KVM over Ubuntu 20.04 LTS KVM over Ubuntu 22.04 LTS KVM over Ubuntu 24.04 LTS KVM over Debian 12 KVM over Rocky Linux	VMware vSphere ESXi 6.X Nutanix AHV Acropolis Hypervisor Proxmox Virtual Environment KVM over RHEL 7.X KVM over RHEL 8.X KVM over RHEL 9.X KVM over Ubuntu 16.04 LTS KVM over Ubuntu 18.04 LTS Microsoft Hyper-V over Windows Server 2016 (2) Microsoft Hyper-V over Windows Server 2019 (2) Microsoft Hyper-V over Windows Server 2022 (2)
Management and Orchestration		VMware vCenter 7.X VMware vCenter 8.X OpenStack Zed (vanilla distribution)	VMware vCenter 6.X Other OpenStack-based platforms (vanilla distributions) Other OpenStack-based platforms (vendor-specific distributions)
Public Cloud		Amazon Web Services Marketplace Google Cloud Platform Marketplace (4) Microsoft Azure Marketplace (3) Oracle Cloud Infrastructure	N / A
Network Connection and vNIC Driver	**Virtual Switch**	VMware vSwitch 1G –> 400G vmxnet3 KVM Linux Bridges 1G –> 400G virtio KVM Open Virtual Switch 1G –> 400G virtio	HV vSwitch 1G / 10G hv_netvsc (2)
	PCI-PT	Intel 350 1G igb (5) Intel 5xx 10G ixgbe Intel 71x 10G / 25G / 40G i40e Intel 81x 10G / 25G / 50G / 100G ice Mellanox ConnectX-4 10G / 25G / 50G / 100G mlx5 Mellanox ConnectX-5 10G / 25G / 50G / 100G mlx5 Mellanox ConnectX-6 10G / 25G / 50G / 100G / 200G mlx5 Mellanox ConnectX-7 10G / 25G / 50G / 100G / 200G / 400G mlx5 Mellanox BlueField-2 10G / 25G / 50G / 100G / 200G mlx5 Mellanox BlueField-3 10G / 25G / 50G / 100G / 200G / 400G mlx5 Broadcom BCM57608 10G / 25G / 50G / 100G / 200G / 400G bnxt (1)	N / A
	SR-IOV	Intel 350 1G igbvf (5) Intel 5xx 10G ixgbevf Intel 71x 10G / 25G / 40G iavf Intel 81x 10G / 25G / 50G / 100G iavf Mellanox ConnectX-4 10G / 25G / 50G / 100G mlx5 Mellanox ConnectX-5 10G / 25G / 50G / 100G mlx5 Mellanox ConnectX-6 10G / 25G / 50G / 100G / 200G mlx5 Mellanox ConnectX-7 10G / 25G / 50G / 100G / 200G / 400G mlx5 Mellanox BlueField-2 10G / 25G / 50G / 100G / 200G mlx5 Mellanox BlueField-3 10G / 25G / 50G / 100G / 200G / 400G mlx5 Broadcom BCM57608 10G / 25G / 50G / 100G / 200G / 400G bnxt (1)	N / A
Virtual Switch Model		Virtual Standard Switch (on VMware) Virtual Distributed Switch (on VMware) Linux Bridges (on KVM)	Hyper-V Virtual Switch (on Microsoft Hyper-V)

Category	Qualified		Compatible
	Open Virtual Switch Open Virtual Switch	(on KVM) (on OpenStack)	Linux Bridges (on OpenStack)

(1) Supported only when using the Cloud Architecture : DPDK / SR-IOV / PCI-PT together with Broadcom BCM57608 NIC.
(2) Supported only when using the Cloud Architecture : DPDK / SR-IOV / PCI-PT inside Microsoft Hyper-V hypervisors.
(3) Supported only when using the Cloud Architecture : DPDK / SR-IOV Accelerated Networking inside Microsoft Azure.
(4) Supported only when using the Cloud Architecture : Google Virtual NIC (gVNIC) inside Google Cloud Platform.
(5) Supported only when using the Virtual Architecture : Intel i350 1G NIC connected in PCI-PT / SR-IOV without DPDK.

Network Protocols

IxNetwork VE 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	Virtual Architecture	Cloud Architecture
Interfaces	MAC	Y	Y
	VLAN	Y	Y
	IPv4 (ARP / PING)	Y	Y
	IPv6 (NDP / SLAAC / PING)	Y	Y
Routing / Switching	BGPv4 / BGPv6	Y	Y
	EIGRP / EIGRPv6	Y	N
	ISISv4 / ISISv6	Y	Y
	OSPFv2 / OSPFv3	Y	N
	PIM-SM / PIM-SSM	Y	N
	RIP / RIPng	Y	N
	BFD	Y	N
	STP / RSTP / MSTP	Y	N
	PVST+ / RPVST+	Y	N
	LACP / Link Aggregation	Y	N
	LACP / Protocols (PoLACP)	Y	N
Software Defined Network	Segment Routing BGP Prefix SID	Y	N
	Segment Routing ISIS	Y	N
	Segment Routing OSPF	Y	N
	Segment Routing v6 / G-SRv6	Y	N
	Segment Routing v6 / G-SRv6 OAM	Y	N
	BGP FlowSpec	Y	N
	BGP Link State (BGP-LS)	Y	N
	BGP SR TE Policy	Y	N
	BIER	Y	N
	NETCONF	Y	N
	OpenFlow	Y	N
	OVSDB	Y	N
	PCEP	Y	N
	S-BFD	Y	N
	GENEVE	Y	N
	VXLAN	Y	N
	VXLAN EVPN	Y	N
	ISIS / OSPFv2 Flex-Algo	Y	N
	gRIBI	Y	N
Others	eCPRI	Y	N
	ESMC	Y	N
	NTP	Y	N

Technology	Protocols	Virtual Architecture	Cloud Architecture
MPLS	RSVP-TE P2P / RSVP-TE P2MP	Y	N
	LDP / LDPv6 / mLDP	Y	N
	L3 MPLS VPN / 6VPE / 6PE	Y	N
	L2 LDP VPN / PWE / VPLS	Y	N
	BGP VPLS / VPWS	Y	N
	BGP RFC3107	Y	N
	EVPN / PBB-EVPN	Y	N
	Multicast VPN Rosen Draft	Y	N
	Multicast VPN NG	Y	N
	MPLS OAM	Y	N
	MPLS TP	Y	N
	MPLS over GRE	Y	N
	MPLS over UDP	Y	N
Broadband / Access / Authentication	PPPoE / L2TPv2	Y	N
	DHCPv4 / DHCPv6	Y	N
	DHCPv4 / DHCPv6 over EoGRE	Y	N
	IPv6 Autoconfiguration (SLAAC)	Y	N
	Bonded GRE	Y	N
	IGMP / MLD	Y	N
	802.1x	Y	N
	ANCP	Y	N
Industrial Ethernet	CFM IEEE 802.1ag	Y	N
	Link OAM IEEE 802.3ah	Y	N
	Service OAM ITU-T Y.1731	Y	N
	PBT / PBB-TE	Y	N
	E-LMI	Y	N
	TWAMP	Y	N
Data Center Ethernet	DCBX / LLDP	Y	N
	FCoE / FIP	Y	N
	FCoE Forwarder	Y	N
	FabricPath	Y	N
	SPBM	Y	N
	TRILL	Y	N
Application Library	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.	Y	N

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.

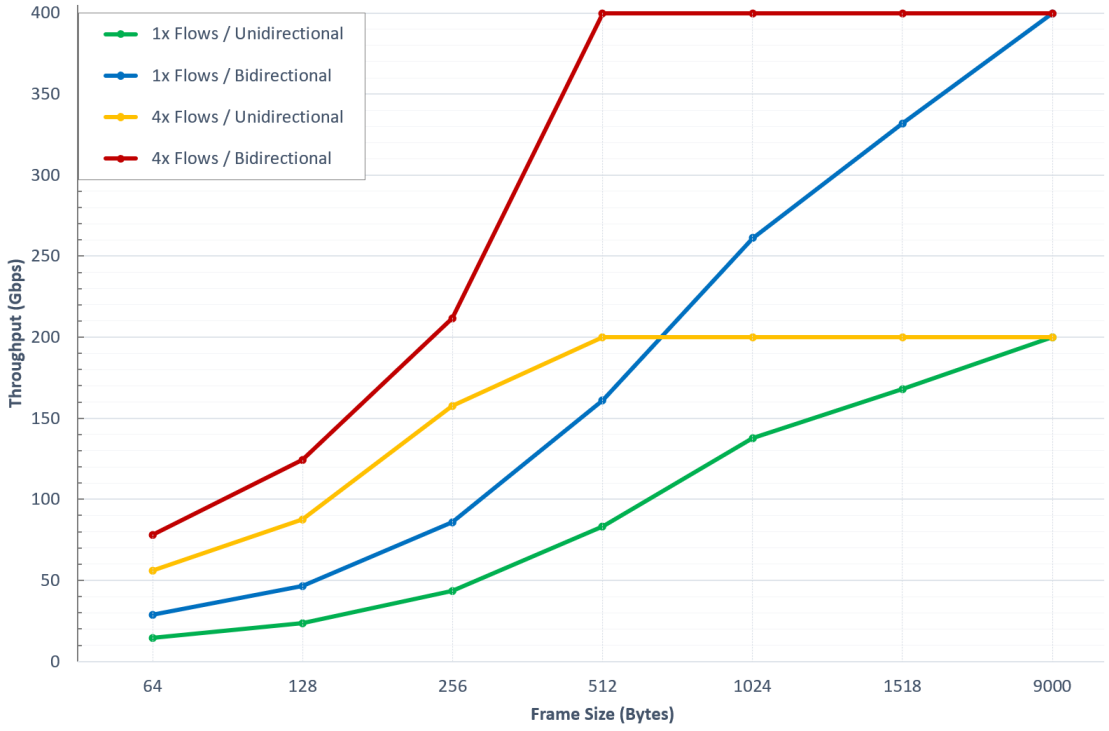
Traffic Generator	Specification
Configuration	Advanced Traffic Wizard – step by step wizard traffic configuration Quick Flow Group – granular control of packet sequence and variations
Scale	Per Application — Up to 16,000 Flow Groups Per Application — Up to 4,000,000 Trackable Flows / 22 Tracking Bits Per Virtual Port — Up to 4,096 Flow Groups Per Virtual Port — Up to 65,536 Trackable Flows / 16 Tracking Bits
Traffic Types	IPv4, IPv6, MPLS multi-labels, Ethernet, VLAN, Provider Bridges (Q-in-Q), Provider Backbone Bridges (MAC-in-MAC), L2 MPLS VPN, L3 MPLS VPN, VPLS, 6PE, 6VPE, Multicast, Multicast VPN
Mapping Source / Destination	One-to-one, many-to-many, fully meshed
Mapping Routes	One-to-one, fully meshed
Traffic Dynamic Controls	Change frame rate and frame size on the fly
Traffic Frame Size	Fixed Increment Random IMIX IMIX Custom Auto
Traffic Payload Pattern	Increment Byte Increment Word Decrement Byte Decrement Word Random Custom
Traffic QoS	IPv4 TOS IPv4 DSCP IPv6 Traffic Classes IEEE 802.1p VLAN CoS MPLS EXP
Traffic Rate	Percent Line Rate Packets Per Second Layer 2 Bit Rate (bps, Kbps, Mbps, Bps, KBps, MBps)
Traffic Tracking Per-Flow	Single or multi-field tracking of any field including: • Source MAC Address • Destination MAC Address • Source IP Address • Destination IP Address • Source TCP Port • Destination TCP Port • Source UDP Port • Destination UDP Port • VLAN ID • VLAN Priority

Traffic Generator	Specification
	• MPLS Label • MPLS Flow Descriptor • QoS (TOS / DSCP) • Source / Destination MAC Pair • Source / Destination IP Pair • Source / Destination Port Pair • Flow Group • Frame Size • Custom Packet Tracking
Real-time Flow Filtering / Flow Detective	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
Traffic Flow Control	N / A
Traffic Packet Editor	• Edit Headers: Single Value, Increment, Decrement, List, Random • Set Meshing: Default, Link / Unlink with other headers, Fully Mesh • Add Tracking: Track user defined traffic flows based on any header
Traffic Loss	Tx Frames Rx Expected Frames Rx Frames Rx Bytes Frame Delta Loss %
Traffic Rate	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)
Traffic Latency (based on NTP)	Min Latency Avg Latency Max Latency
Basic Sequence Checking	Small Error Big Error Reverse Error Duplicate Frames Sequence Gaps Last Sequence Number
Advanced Sequence Checking	Lost Frames In Order Frames Reordered Frames Duplicate Frames Late Frames Last Sequence Number
Time Stamps	First Timestamp Last Timestamp
Data Integrity	Data Integrity Frames Data Integrity Errors
Packet Loss Duration	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 which results in increased data plane performance required to validate the latest generation Virtual Network Functions. The traffic throughput is improved by up to 8x thanks to the DPDK Performance Acceleration. The throughput can be further increased by aggregating multiple traffic flows across different Virtual Functions belonging to the same SR-IOV-enabled physical NIC.

Frame Size	Scenario #1		Scenario #2		Scenario #3		Scenario #4	
	1x Flows / Unidirectional		1x Flows / Bidirectional		4x Flows / Unidirectional		4x Flows / Bidirectional	
Bytes	Mpps	Gbps	Mpps	Gbps	Mpps	Gbps	Mpps	Gbps
64	21.54	14.5	42.57	28.6	83.58	56.2	116.33	78.2
128	19.85	23.5	39.22	46.4	73.93	87.5	104.92	124.2
256	19.63	43.3	38.96	86.0	71.39	157.6	95.92	211.8
512	19.59	83.4	37.84	161.0	46.99	200.0	93.98	400.0
1,024	16.49	137.7	31.28	261.2	23.95	200.0	47.89	400.0
1,518	13.67	168.2	26.97	331.9	16.25	200.0	32.51	400.0
9,000	2.77	200.0	5.54	400.0	2.77	200.0	5.54	400.0



The topology consists of 1x Virtual Chassis (2 vCPU / 4 GB RAM) and up to 8x Virtual Load Modules (4 vCPU / 4 GB RAM each) depending on the benchmarking scenario. The traffic profile consists of IPv4 flows running between TX / RX endpoints configured and provisioned as described in the table below.

Scenario	DPDK	Direction	Virtual Machine #			Traffic Engine Virtual CPU #		
			TX	RX	TOTAL	TX	RX	TOTAL
#1	ON	1	1	1	2	1	1	2
#2	ON	2	2	2	2	2	2	4
#3	ON	1	4	4	8	4	4	8
#4	ON	2	8	8	8	8	8	16

The performance numbers were benchmarked on a platform composed of 1x Supermicro Super Server with 1x Intel Xeon Platinum 8370C CPU (32 cores / 64 threads / 2.80 GHz) and 2x NVIDIA ConnectX-6 200G NIC (PCI Express 4.0 / SR-IOV enabled / MCX653105A-HDAT) running VMware ESXi 8.0.0 (20513097) hypervisor. More details regarding the test methodology can be found in this blog post.

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 / flow-level.
- Different modes to view traffic statistics (Instantaneous / Cumulative / Both).
- CSV files can be used to capture a single result view or to capture all global results in real-time.
- CSV viewer integration into the application is provided to view large-result files.

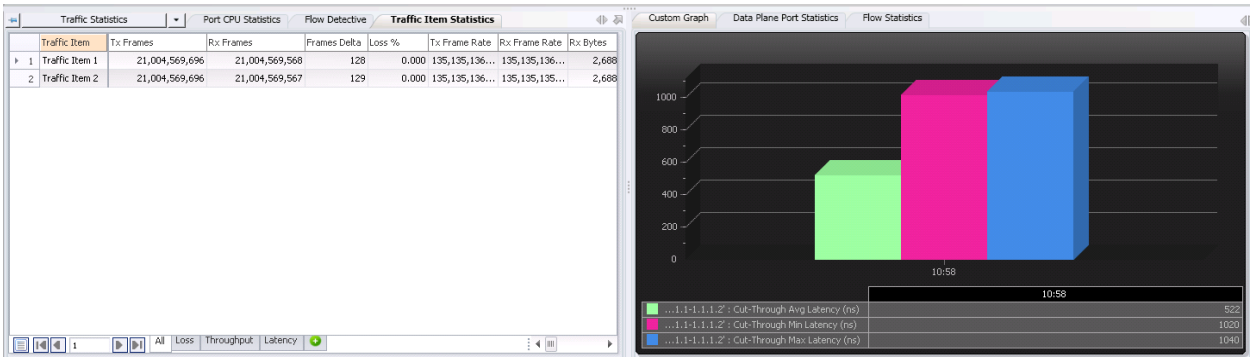


Figure 3. Statistics viewer

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

Function	Statistics
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.

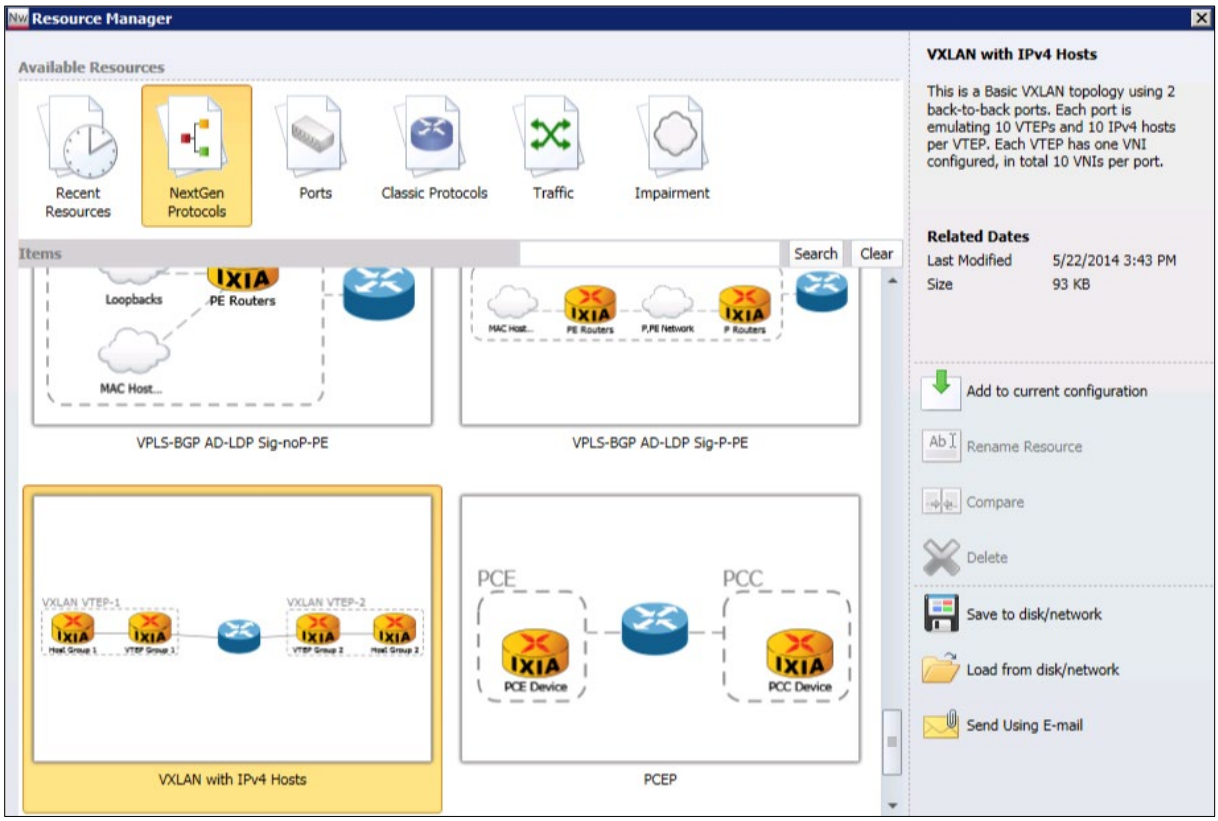


Figure 4. Resource manager

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
QuickTest	Scalability	• Standards-based IETF RFC test methodologies • Custom mode for user-defined performance tests • Easy-to-use, configurable, pre-packaged tests • Generate detailed reports of results
Macro Recorder	Functionality	• 'Click-thru automation' means no more scripting • Rapid capture of manual test cases • Capture steps that cause a failure for reproducibility
Test Composer and Tweakables	Regression	• GUI-based solution to automate test actions • Detailed control over test execution without TCL expertise • Complete access to the TCL API with easy UI • Edit Macro Recorded steps for customization of GUI captured events
ScriptGen	Regression	• Provides an easy, one-click GUI-to-script generation
Low-level and High-level APIs	Functionality and regression	• For TCL scripting experts • One-click GUI to TCL script conversion available (ScriptGen) • Complete access to and control over test configuration • REST, TCL, Perl, Python, and Ruby API support

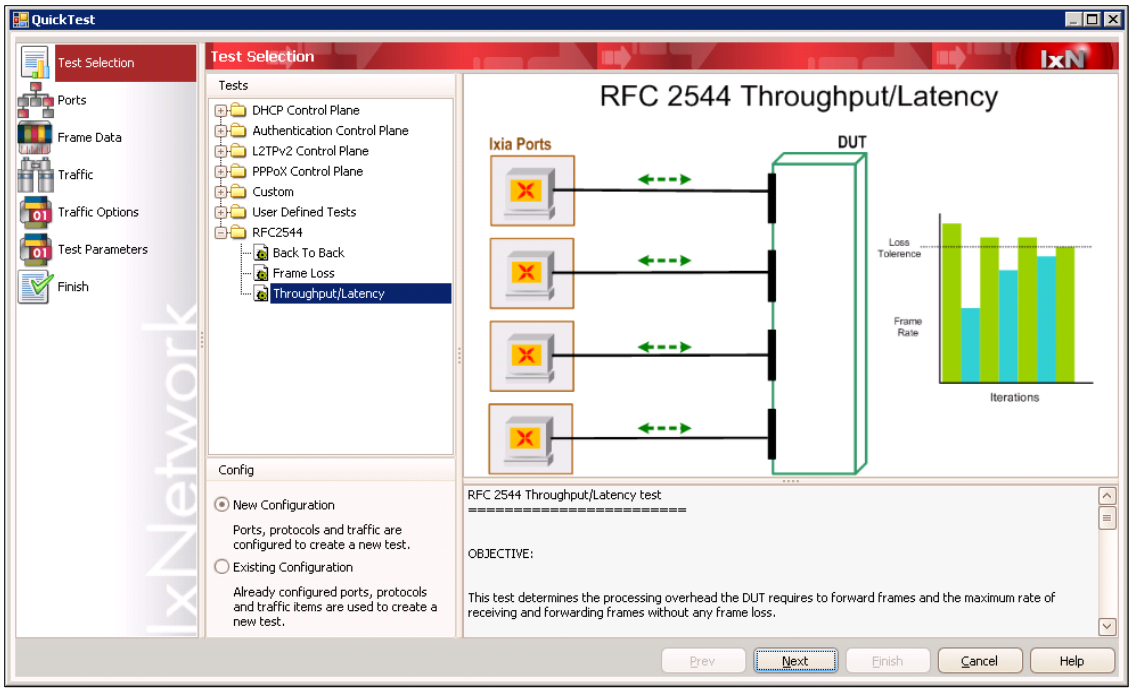


Figure 5. QuickTest end-to-end wizards

QuickTest	Tests	Virtual Architecture	Cloud Architecture
RFC 2544 tests	Throughput and Latency, Frame Loss, Back-to-Back	Y	Y
RFC 2889 tests	Broadcast Rate, Fully Meshed, Many to One, One to Many, Partially Meshed	Y	Y
RFC 3918 tests	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	Y	Y
ITU-T Y.1564 Service Activation	Service Configuration, Service Performance	Y	Y
Asymmetric Data Performance	Throughput / Latency, Frame Loss	Y	Y
Control Plane tests	Session Setup Rate, Session Capacity	Y	N
Converged Data Center	Cloud Performance	Y	N
OpenFlow	Failover Performance, L2 Address Learning, L3 Address Learning, Switch Flow Table Capacity	Y	N
Custom tests	Continuous, Fixed Duration Run, Incremental, Throughput (binary search)	Y	Y
User-Defined tests	Tests defined in Test Composer	Y	Y

Technology Solutions

Visit 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 (Virtual Edition) Tier-0 1G (12-Months Floating Worldwide License, Keysight software support subscription). Includes the following IxNetwork capabilities supported on IxNetwork VE for the purchased term: Control Plane (IPv4 / IPv6 interfaces), Data Plane (all traffic), Extra Features (IxExplorer). Enables support for Control Plane performance (very low scale) and Data Plane performance (up to 1 Gbps throughput) per unit. Requires license term to be specified (must be purchased in multiples of years, list price is per unit per year). TAA Compliant.

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For more information, see:
https://www.keysight.com/in/en/products/network-test/protocol-load-test/ixnetwork-ve.html

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