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 the functional and performance testing of physical and virtual network infrastructure, capacity, scalability, and convergence using scaled protocol emulation and traffic. 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 1Gbps and 10Gbps increments. For data center/cloud computing environments, IxNetwork VE can benchmark the performance of virtualized servers by simulating data center traffic between virtual machines (VMs). 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.

HIGHLIGHTS

- Test the most critical components of virtual and physical products, including functionality, conformance to standards, and performance

- Accelerate time to market by conducting functional tests early in the development lifecycle

- Pinpoint and isolate datacenter deployment and performance issues using Ixia virtual test tools' flexible deployment that can be easily moved, changed, or scaled up and down

- Assess how VM mobility impacts application reliability and scalability

- Validate NFV migration by testing within OpenStack-based private clouds

- Leverage subscription-based licensing that enables low startup cost and flexibility of pay-as-you-grow OPEX model

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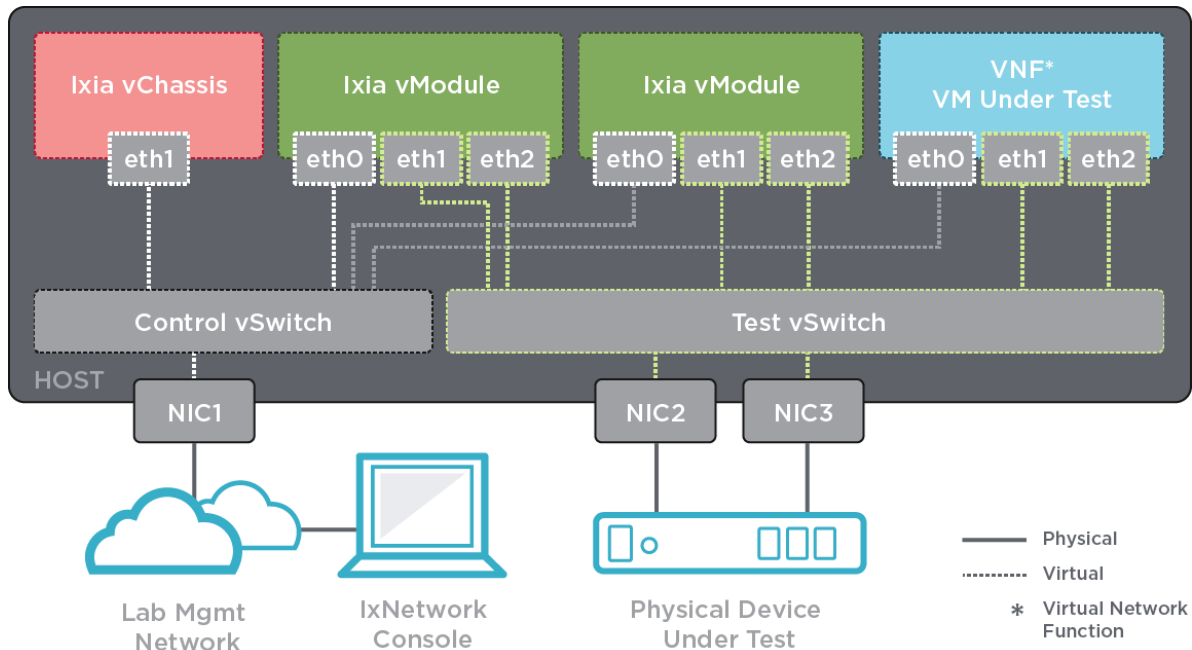
IxNetwork VE deployment for both virtual and physical device testing

KEY FEATURES

- Provides comprehensive protocol coverage for routing/switching, multiprotocol label switching (MPLS), broadband access, data center networking, and SDN

- Powerful traffic generation and statistics engine including stateless L2-3 traffic and stateful L4-7 application flows

- Common IxNetwork user interface across both Ixia hardware and virtual products enables end-to-end virtual- and hardware-based testing from a single pane of glass

- VMs of the Ixia hardware components (virtual chassis, virtual load modules) are software that is optimized for protocol emulation and traffic generation in a virtual environment

- Comprehensive platform support including standalone hypervisors (VMware ESXi and KVM) and OpenStack-based private clouds

- Seamless transition between Ixia hardware and virtual platforms, enabling easy translation of functional and performance testing in physical or virtual environments

- Flexible all-inclusive subscription licensing model reduces startup cost

- Common licensing server shared among IxLoad VE, IxNetwork VE, and BreakingPoint VE

- Full automation capabilities with REST, TCL, Perl, Python, and Ruby API support
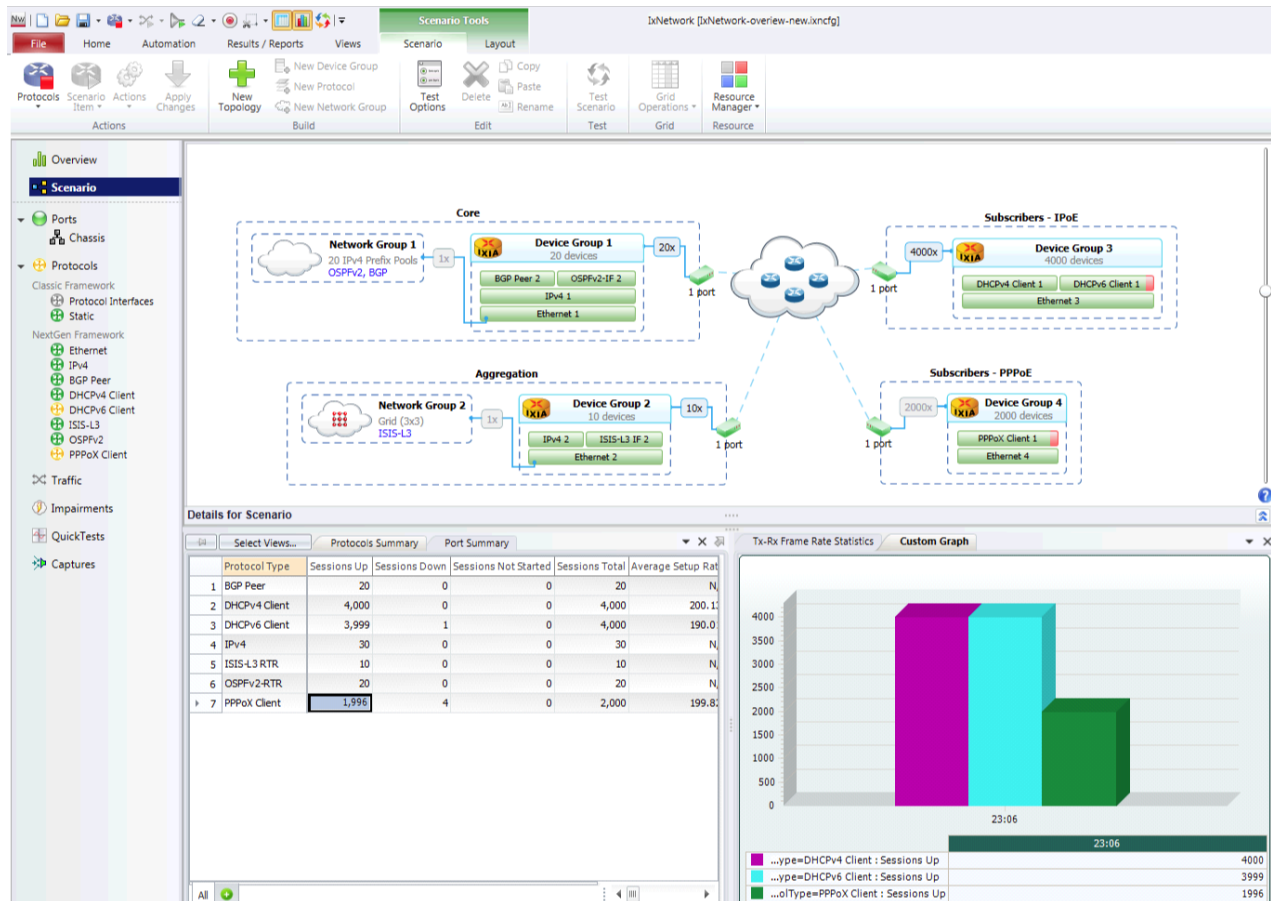
IxNetwork real-world network toplogy viewer with per-session protocol drill-down

SPECIFICATIONS

IxNetwork VE features, functions, and capacities for the Ixia virtual chassis and load modules.

FEATURE	VIRTUAL CHASSIS	VIRTUAL LOAD MODULE
Maximum # of Virtual Ports	128	32 (depends on host system)[i]
Maximum # of Virtual Load Modules	32	N / A
Maximum # of Users	32	1
Guest OS	• Windows 7 Professional • Windows 8.1 Enterprise • CentOS 7	• Based on CentOS 6.3 / 64-bit / Linux 3.10 enhanced kernel

Distribution/ Packaging
(Linux version)
	• VMware:
	   ○ SH (automatic deployment)
	   ○ OVA (manual deployment)
	• KVM:
	   ○ SH (automatic deployment)
	   ○ QCOW2 (manual deployment)
		• VMware:
		   ○ SH (automatic deployment)
		   ○ OVA (manual deployment)
		   ○ RPM (manual deployment)
		• KVM:
		   ○ SH (automatic deployment)
		   ○ QCOW2 (manual deployment)
		   ○ RPM (manual deployment)

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 environments. In case there are issues encountered in these environments, Ixia will make reasonable efforts to address them, but cannot guarantee specific outcomes or results. In such rare cases, the proposed solution is to use the qualified environment.

CATEGORY		QUALIFIED	COMPATIBLE
Hypervisor and Host OS		- VMware vSphere ESXi 6.X - KVM over CentOS 7.X - KVM over Ubuntu 14.04 LTS	- VMware vSphere ESXi 5.X - KVM over CentOS 6.X - KVM over Ubuntu 12.04 LTS - KVM over RHEL 6.X - KVM over RHEL 7.X
Management and Orchestration		OpenStack Liberty (vanilla distribution)[ii]	- VMware vCenter 5.X[ii] - VMware vCenter 6.X[ii] - Other OpenStack-based platforms (vanilla distributions)[ii] - Other OpenStack-based platforms (vendor-specific distributions)[ii]
Network Connection and vNIC Driver	**Virtual Switch**	- VMXNET3 (VMware) - VIRTIO (KVM)	N/A
	PCI Pass-Trough	- Intel 1G IGB (all platforms) - Intel 10G IXGBE (all platforms)	
	SR-IOV	- Intel 1G IGBVF (all platforms) - Intel 10G IXGBEVF (all platforms)	
Virtual Switch Model		- Virtual Standard Switch (only on VMware) - Linux Bridges (only on KVM) - Open Virtual Switch (only on OpenStack)[ii]	- Virtual Distributed Switch (only on VMware)[ii] - Open Virtual Switch (only on KVM)[ii] - Linux Bridges (only on OpenStack)[ii]

NETWORK PROTOCOLS

IxNetwork emulates a wide variety of networking protocols. Using the IxNetwork test application, each Ixia 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 hardware or virtual test ports. Combined with traffic generation and QoS measurement capabilities, the hardware load modules and virtual load modules verify advertised topologies and networks for reachability and QoS performance.

TECHNOLOGY	PROTOCOL
Interfaces	MAC, VLAN, IPv4 (ARP, PING), IPv6 (NDP, SLAAC, PING)
Routing and Switching	BGP-4, BGP+, OSPFv2/v3, ISISv4/v6, EIGRP, EIGRPv6, RIP, RIPng, BFD, IGMPv1/v2/v3, MLDv1/v2, PIM-SM/SSM, PIM-BSR, STP/RSTP, MSTP, PVST+/RPVST+, Link Aggregation (LACP), LLDP
Software Defined Network	VXLAN, EVPN VXLAN, OpenFlow, ISIS Segment Routing, OSPF Segment Routing, BGP Segment Routing, BGP Link State (BGP-LS), PCEP, OVSDB
MPLS	RSVP-TE, RSVP-TE P2MP, LDP/LDPv6, mLDP, PWE, VPLS-LDP, VPLS-BGP, BGP auto-discovery with LDP FEC 129 support, L3 MPLS VPN/6VPE, 6PE, BGP RT-Constraint, BGP Labeled unicast, L3 Inter-AS VPN Options (A, B, C), Multicast VPN (GRE, mLDP, RSVP-TE P2MP), EVPN, PBB-EVPN
Broadband and Authentication	PPPoX, DHCPv4, DHCPv6, L2TPv2, ANCP, IPv6 Autoconfiguration (SLAAC), IGMPv1/v2/v3, MLDv1/v2
Industrial Ethernet	Link OAM IEEE 802.3ah, CFM IEEE 802.1ag, Service OAM ITUT-Y.1731, PBT/PBB-TE, ELMI
Data Center Ethernet	FCoE/FIP, LLDP/DCBX, TRILL, TRILL OAM, SPBM, Cisco FabricPath
Application Traffic	Hundreds of AppLibrary flows inside IxNetwork-AppLibrary

TRAFFIC

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 – steps by steps wizard assisted traffic configuration Quick FlowGroup – granular control of packet sequence and variations	
Scale	Generate up to 4 million trackable flows using IxNetwork application Configure up to 16,000 unique Flow Groups – each supporting a unique transmit profile Up to 256 Flow Groups per-port Up to 4,096 trackable receive flows per port	
Dynamic Controls	Change frame rate and frame size on the fly	
Traffic Types	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	
Source/Destination Ports Mapping	One–to-one, many-to-many, fully meshed	
Routes Mapping between Peer Ports	One-to-one, fully meshed	
Flow Grouping	Build flow groups based on packet content (e.g., QoS or VLAN ID)	
Traffic Profile	Frame size	Fixed, increment, random, IMIX, custom IMIX, Quad Gaussian distribution, auto
	Rate	percent line rate, packets/sec, L2 bit rate (bps, Bps, KBps, MBps)
	Payload pattern	Increment byte/word, decrement byte/word, random, custom
	QoS	TOS, DSCP, IPv6 traffic classes, 802.1p, MPLS EXP
	Dynamic	Traffic supports gratuitous ARP - auto Re-ARP

| TRAFFIC GENERATOR	SPECIFICATION	
Per-Flow Traffic Tracking	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, Src/Dst IP pair, Src/Dst MAC pair, custom packet tracking	
Real-Time Flow Filtering and 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 using sequence, identify dead flows	
Packet Editor	Edit packet header fields and payload	
Flow Control	N/A	
Packet Editor	Header field value editing	
	Add tracking	Increment, decrement, list, user defined, default, link/unlink with other header fields
	Payload editing	Track user defined traffic flows
	Custom editing	Increment byte/word, decrement byte/word, repeat, fixed, user defined

MEASUREMENT	SPECIFICATION
Loss	Track Tx frames, Rx expected frames, Rx frames, Rx bytes frame delta loss %
Rate	Tx frame rate, Rx frame rate, Rx rate (bps, Bps, Kbps, Mbps)
Latency	Store and forward, cut-through, MEF frame delay, forwarding delay. IxNetwork VE latency measurements are based on NTP
Sequence	Small error, big error, reverse error, last sequence number, duplicate frames, sequence gaps
Time Stamps	First and last timestamp per flow
Packet Loss Duration	Estimated time without received packets calculated by frames delta at the expected Rx rate

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 displayed 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
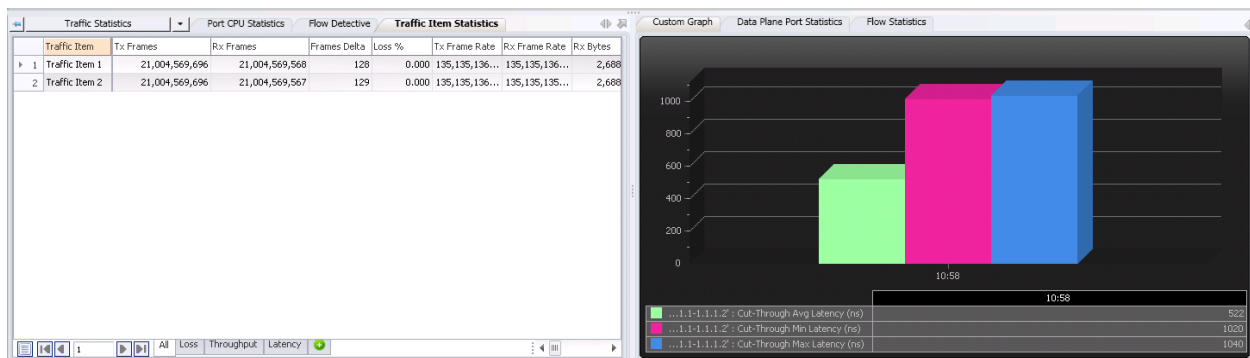

Statistics Viewer

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.
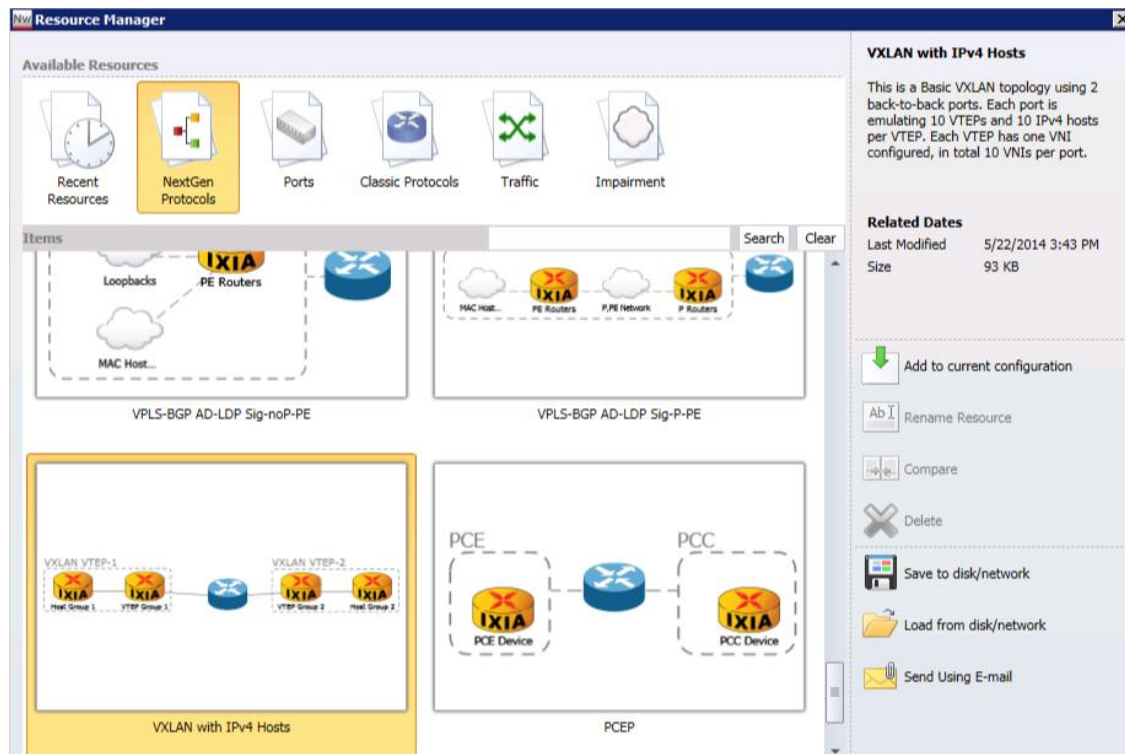
Resource Manager

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.

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. IxNetwork's automation is simplicity at its best. Test scenarios are set up using IxNetwork's 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 – providing real-time statistics and state information.

TYPES	TEST REQUIREMENT	DETAIL
QuickTest	Scalability	• Standards-based IETF RFC test methodologies, as well as a 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
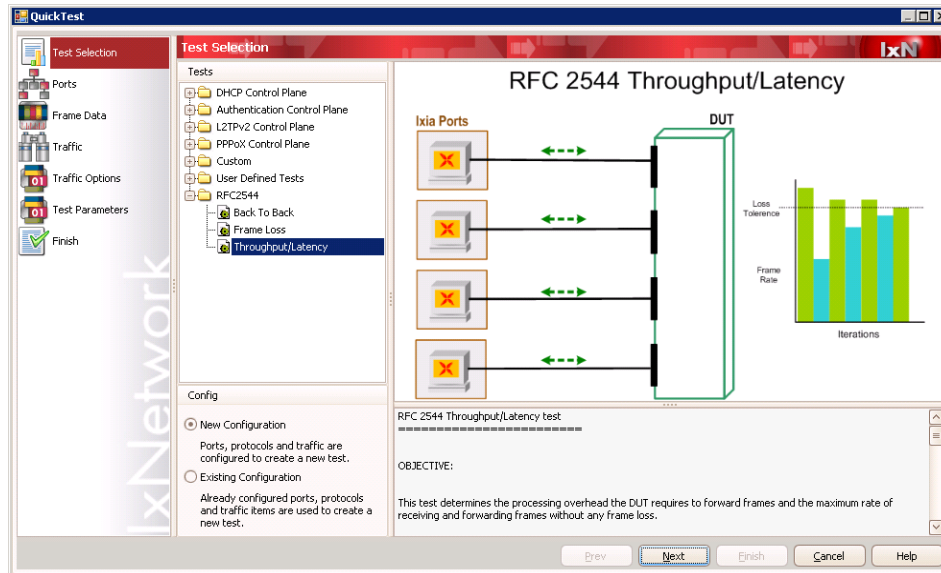
QuickTest end-to-end wizards

QUICKTEST	TESTS
RFC 2544 Tests	Throughput and latency, frame loss, back-to-back
RFC 2889 Tests	Broadcast Rate, Congestion Control, Frame Error Filtering, Fully Meshed, Many to One, One to Many, Partially Meshed
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
ITU-T Y.1564 Service Activation	Service Configuration, Service Performance
Asymmetric Data Performance	Throughput/Latency, Frame Loss
Control Plane Tests	Session setup rate, session capacity
OpenFlow	Failover Performance, L2 Address Learning, L3 Address Learning, Switch Flow Table Capacity
Custom Tests	Continuous run, fixed duration run, incremental, throughput (binary search)
User-Defined Tests	Tests defined in Test Composer

BUILT-IN DATA CAPTURE AND ANALYSIS

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

TECHNOLOGY SOLUTIONS

VISIT IXIACOM.COM FOR MORE INFORMATION ON IXNETWORK AND IXIA VIRTUALIZATION SOLUTIONS
• IxNetwork Overview—L2/3 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

ORDERING INFORMATION

939-9510

IxNetwork VE Tier-0 FLOATING Subscription license. Includes the IPv4 / IPv6 protocols on IxNetwork VE for a duration of 1-Year.

Supports 1 Gig throughput per unit.

939-9501

IxNetwork VE Tier-1 FLOATING Subscription license. Includes all IxNetwork protocols supported on IxNetwork VE for a duration of 1-Year.

Supports 1 Gig throughput per unit and low scale control plane.

939-9502

IxNetwork VE Tier-2 FLOATING Subscription license. Includes all IxNetwork protocols supported on IxNetwork VE, all IxNetwork QuickTests, all Test Automation (Macro Recorder, Test Composer licenses) features and IxReporter for a duration of 1-Year.

Supports 1 Gig throughput per unit and medium scale control plane.

939-9503

IxNetwork VE Tier-3 FLOATING Subscription license. Includes all IxNetwork protocols supported on IxNetwork VE, all IxNetwork QuickTests, and all Test Automation (Macro Recorder, Test Composer licenses) features, IxReporter, IxNetwork-FT and AppLibrary for a duration of 1-Year.

Supports 1 Gig throughput per unit and high scale control plane.

939-9523

IxNetwork VE Tier-3 FLOATING 10G Subscription license. Includes all IxNetwork protocols supported on IxNetwork VE, all IxNetwork QuickTests, and all Test Automation (Macro Recorder, Test Composer licenses) features, IxReporter, IxNetwork-FT and AppLibrary for a duration of 1-Year.

Supports 10 Gig throughput per unit and high scale control plane.

[i] The number of virtual NICs depends on the host system configuration and specification.
[ii] Automatic deployment via Deployment Wizard is not supported.