ACL Digital
an ALTEN group company

Ixia Test Solutions to Ensure Stability of its New, LXC-based Virtual Customer Premises Equipment (vCPE) Framework for Residential and SMB Markets

Company

ACL Digital is a pioneer in SDN and NFV solutions.

Market

Networking and cloud infrastructure solutions.

Challenges

Verify the stability of a new Virtual Customer Premises (vCPE) Framework in 1) a fully virtualized (KVM) environment; and 2) a Linux Container (LXC)-based environment.

Solution

- Ixia Xcellon-Ultra XTS40 8x10Gbps with IxLoad and Ixia XM2/NGY-NP8-01 8x10Gbps load module with IxNetwork.
- High performance to emulate over a million L4 sessions at throughput of several Gbps.
- Client and server emulation in a single appliance.
- Centralized user interface for traffic definition and constraint settings.
- Rich graphical network statistics visualization.
- Report generation tools to populate detailed test reports.
- Customizable live traffic statistics based on L2-L4 parameters of interest.
- Multi-protocol testing of diverse traffic.

A Leap Forward for SDN and NFV

Network Functions Virtualization (NFV) is greatly changing today's networking. This new approach moves switching, routing, firewalls, and broadband remote access servers (BRAS), from special hardware to cost-efficient commercial off-the-shelf (COTS) server-based platforms.

With NFV come challenges along with the new business opportunities and cost savings. Hence, Network Equipment Manufacturers (NEMs) must create virtual network functions (VNFs) that can run on COTS hardware. NEMs are working hard to virtualize their products and service providers are creating services that run on virtualized systems. To gain from this progress, protocols must work smoothly and well with specifications.

ACL Digital always tries to meet customer needs with new and promising technologies. So they turned to Ixia to test the key network functions of their products.

This testing helps to make sure that the ACL Digital environments handle bi-directional line rate traffic well along with the physical environments.

The Challenges of KVM and LXC

ACL Digital's NFV teams have used Ixia equipment before to test and improve their products. For example, Ixia tested Virtual Network Function (VNF) performance for throughput and scalability. Now, the ACL Digital's Networking and Infrastructure Solutions Division (NISD) is using Ixia testing to help develop and roll out Virtual Customer Premises (vCPE) solutions. This testing is for one of the first commercial NFV deployments. Residential and Smaller-to-Medium-Size Business (SMB) subscribers.

ACL Digital wanted to test its new vCPE framework in a fully Virtualized (KVM) environment and in a Linux Container (LXC)- based approach.

The goal was to ensure the stability of ACL Digital's NFV environments. So Ixia products held long duration tests to verify session establishment rates and line rate throughput. This was done under different application payloads. Stability is critical because instantiating or deleting VMs can affect the performance both of existing VMs and of services on the server.

Their policies say that new VMs should get the right number of compute cores and storage without hurting existing services. Ixia solutions are vital to ACL Digital in making sure this works.
They also monitor the continuing stability of the vCPE environment. Another goal of Ixia testing is to create traffic of different packet sizes. This shows that the new solution framework can support payload sizes from 64 bytes to 1420 bytes. ACL Digital also needed multi-protocol traffic testing for IP, TCP, UDP, Routing OSPFv2, RIPv1, RIPv2, HTTP, Telnet, SSH, FTP, and others.

Ixia equipment not only helps ACL Digital test individual protocols but also real-world scenarios end-to-end. This includes the interoperability, performance, and scale of vCPE functions.

ACL Digital Chooses Two Ixia Products for Testing Its Strategic New Offering

Ixia's XTS40 with Ixload™ addresses high-scale TCP based traffic on the vCPE framework.
Ixia's XM2/NGY-NP8-01 with IxNetwork™ emulates the real- time user environment. It tests L2-L4 function of the vCPE framework. IxNetwork also tests L2-L3 features.

Ixia's test products can simulate real-world client and server equipment. This helps verify the statefulness of the firewall. Real-world traffic lets the ACL Digital's team measure exactly how well security appliances are performing. Ixia test products delivered:

Functional and Performance Testing

XTS40 with Ixload™ :

- Verified that the ACL Digital's solution framework could support a high rate of 10Gbps full duplex per port.
- Generated and analyzed TCP-based traffic (HTTP) of 10Gbps per port and UDP-based traffic (Stateless peer) of 10Gbps per port.
- This lets the ACL Digital team verify the system under test for the desired downlink-to-uplink ratio full duplex traffic.

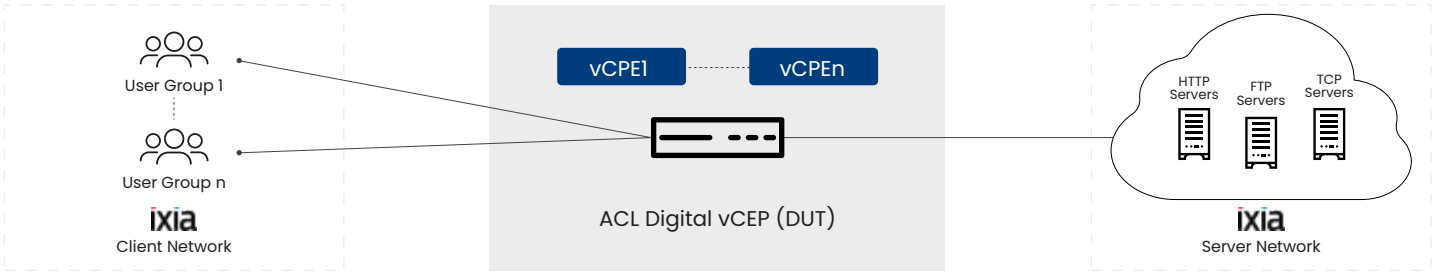
XM2/ NGY-NP8-01 with IxNetwork™ :

- Addressed the high rate of UDP traffic Tested the functionality of L2-L3 features
- Equipment simulation of client and server verifies firewall statefulness
- Real-world stateful traffic generation helps measure how security appliances perform

- True latency measurement makes it easy to setup and measure high-resolution latency of Control Plane and Data Plane messages and events. With backward capability across modules, time stamps could be measured down to a few nanoseconds. Statistics from IxLoad and IxNetwork software helps ACL Digital find any bottlenecks caused by latencies. Testing also improved the framework performance
- Flexibility: Flexible configuration options allow the range of packet sizes to vary (minimum and maximum) with target throughput. This helps ACL Digital test for different traffic packet sizes.
- Scalability testing: Scaled up the TCP or UDP sessions to millions of sessions (500k+L4 sessions)
- Multi-protocol testing: ACL Digital tested their framework under many protocols, including IP, TCP, UDP, Routing OSPFv2, RIPv1, RIPv2, HTTP, FTP, and Telnet SSH

Network Test Implementation

Demo lab network with XTS40



The DUT shown in the diagram above is a COTS server with Intel Xeon E5-2680 v2 processor. Following performance figures were measured Per Core with vCPE Fast Path optimized using Intel DPDK.

Containers (LXC) Environment

TCP Traffic Testing with IxNetwork

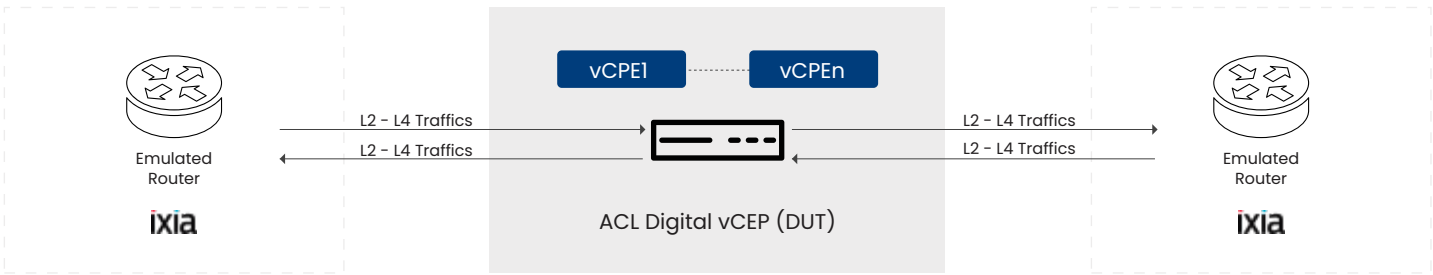
Maximum L2-L3 Throughput per core	7.2 Gbps
Maximum number of subscriber sessions supported per CPU	500k+

VM (KVM) Environment with SR-IOV

TCP traffic testing with IxNetwork

Maximum L2-L3 Throughput per core	5.8 Gbps
Maximum number of subscriber sessions supported per CPU	500k+

Demo lab network with XTS40



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Containers (LXC) Environment

UDP traffic testing with IxNetwork

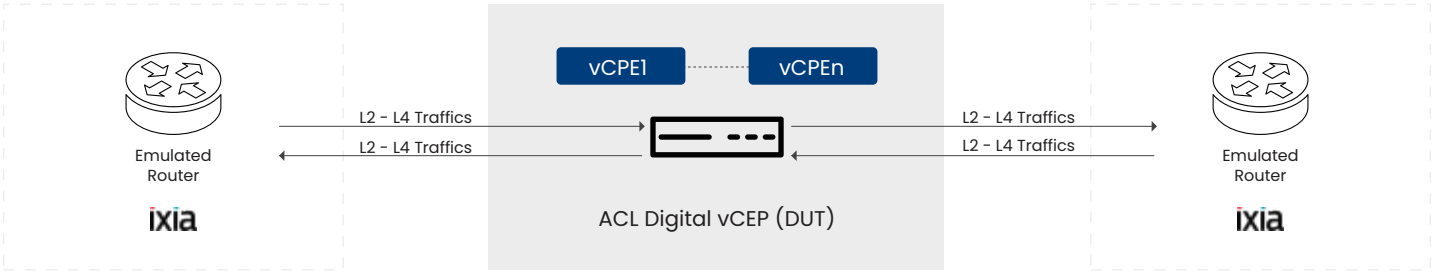
Maximum L2-L3 Throughput per core	16 Gbps
Packets-per-second	1330k PPS at an average packet size of 1500 Bytes
Maximum number of subscriber sessions supported per CPU	500k+

VM (KVM) Environment with SR-IOV

TCP traffic testing with IxNetwork

Maximum L2-L3 Throughput per core	5.8 Gbps
Maximum number of subscriber sessions supported per CPU	500k+

Demo lab Network with XM2/ NGY-NP8-01



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All performance figures mentioned above were found to scale linearly with the number of fast path cores in both cases.

Ixia' s Test Results Prove the Quality

"In our experience, Ixia has always provided high-quality products, with industry-leading testing and test automation capabilities in the datacom space.

As always, we knew that Ixia products can easily meet our testing requirements, and so we chose to go with Ixia equipment to test our vCPE framework. In the future, we plan to rely on Ixia test products to validate multiple VNFs including E-vCPE, vRouter, and more, operating in a simulated network with physical and virtual network elements.

We look forward to the ability to further test our distributed vCPE deployments, including the mobility of vCPE functions between enterprise and service provider NFV infrastructure.

- Narendra Dhara
Senior VP of Engineering and CTO, ACL Digital

Engineering of ACL Digital's vCPE Framework

Ixia products let ACL Digital test its new vCPE in a realistic environment of layer 2-7 traffic generation and subscriber session simulation. This testing validated function and performance of the vCPE framework.

- Test results reveal that ACL Digital's new vCPE framework is capable of delivering industry-leading L2-L3 Throughput >40 Gbps Full Duplex in a fully virtualized (VM) environment with a COTS server using 2x Intel Xeon E5-2680 v2 processors.
- Test results also showed that higher performance >72 Gbps Full Duplex can be achieved using operating system- level virtualization (LXC) with the same COTS server using 2x Intel Xeon E5-2680 v2 processors.

Ixia products helped ACL Digital to generate millions of subscriber traffic flows. These stressed the new vCPE framework and tracked the stability of the solution by instantiating up to 1000 vCPEs with real world traffic conditions.

The tests prove that ACL Digital's vCPE framework delivers high performance consistently over long time periods. The testing also showed that Residential and SMB customers can gain agility and save costs by rolling out high performance Virtual CPE solutions with off-the-shelf server hardware. vCPE on KVM works in a fully virtualized environment where the Guest VM is isolated from the host operating system. This allows us to run different VNFs in the same virtualized environment or NFVI.
Lightweight Linux Containers (LXC) allowed ACL Digital to run larger number of vCPE instances simultaneously with high throughput. vCPE containers are faster to create and shutdown and have low startup times.

By adopting the LXC approach, ACL Digital was able to deliver superior data plane performance and higher vCPE densities (40x - 50x compared to VM deployment) on the same OpenStack orchestrated NFVI.

ACL Digital Pioneered the first SDN & NFV Solutions for OEMs and Service Providers

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- Intel DPDK-based VNF optimization, scaling, and performance testing for NFV architectures
- OpenStack-based orchestration and NFV management framework integration
- Development of SDN controller extensions and SDN applications. These work with OpenFlow™ enabled and legacy (non-OpenFlow) network elements
- Delivery of one of the industry's first OpenFlow enabled datacenter switches
- Development of Element Adapters for diverse vendor devices. These support network services and OAM provisioning
- Ongoing progress since 2013 of the NFV MANO framework In the past, ACL Digital have used Ixia products, including IxNetwork™, IxLoad™, IxANVL™ and IxAutomate™ for functional and performance testing on many different solutions. These range from enterprise switches to metro/core routers.

  Now, thanks to this productive, long-term partnership with Ixia, ACL Digital has become the ideal choice for critical testing of a strategic solution.

ACL Digital is a design-led Digital Experience, Product Innovation, Engineering and Enterprise IT offerings leader. From strategy, to design, implementation and management we help accelerate innovation and transform businesses. ACL Digital is a part of ALTEN group, a leader in technology consulting and engineering services.

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