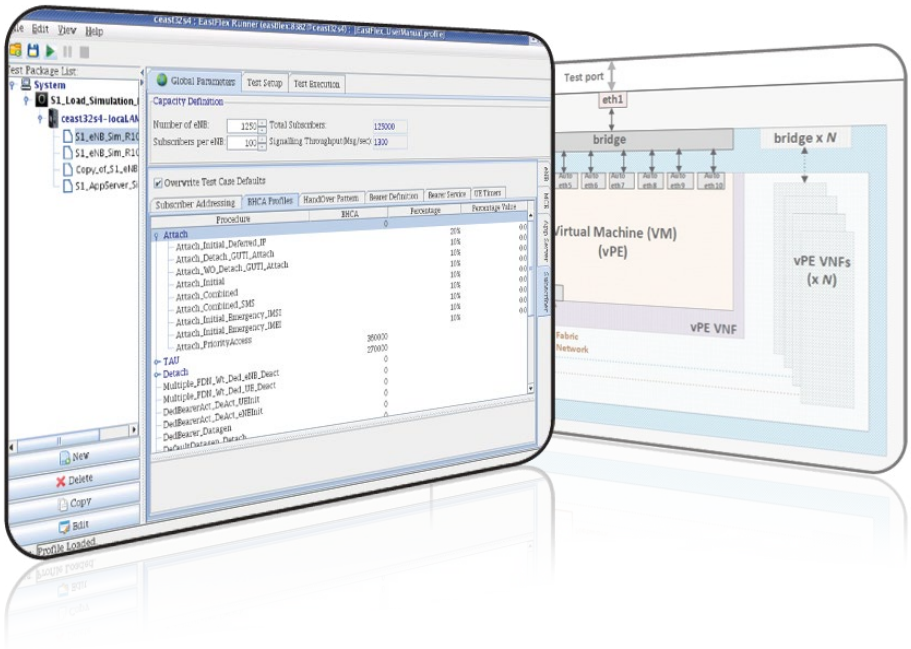
SPEC SHEET

Virtual QualityAssurer

COMPLETE VIRTUALIZED SOLUTION FOR LAB OR LIVE NETWORK NFV TESTING

- High-performance and capacity platform with powerful traffic modeling and automation required for testing next generation networks from development to deployment.



KEY FEATURES

- Lab or live network testing solution for 2G/3G/4G/5G wireless core, RAN and IMS networks, elements and services
- VMware and OpenStack support
- Scalable, multi-user architecture that can grow seamlessly as requirements change
- Engineered for a low total cost of ownership (TCO), upfront as well as on an ongoing basis
- Geared towards applications such as VoLTE, ViLTE, MBB (mobile broadband), RCS and WebRTC
- Ready for IoT and 5G applications such as NB-IoT, high resolution video and low latency use cases
- Engineered to verify NFV networks and their associated features and challenges such as QoE through the VNF life cycle, media processing and network slicing
- Flexible solution: easily customized to every unique test environment
- Powerful traffic-modeling capabilities: accurately reproduce live network conditions in the lab
- Conformance, functional, negative, regression and performance testing from a single platform
- Broad coverage of interfaces and protocols with ready-made test packages and applications that cover standard procedures, with ability to handle non-standard requirements
- Extensive, customizable real-time statistics to analyze network performance, compliance and responsiveness under load conditions
- RESTful API and CLI-based automation capabilities
- Flexible licensing that enables effortless sharing among multiple, concurrent users

NFV IS TRANSFORMING BOTH NETWORKING AND TESTING

NFV is a major transformation for the telecom industry promising lower CAPEX, OPEX and faster time-to-market for new services through standardization, flexibility and automation. It is generally accepted that the NFV ecosystem is still immature. Standardization is still a work in progress, resulting in many variants and proprietary implementations. As a consequence, interworking between VNFs from different vendors is a challenge. Real-time media processing in software also remains a challenge. Reaping the benefits of cloud deployments, elasticity, VNF mobility and other promised NFV features, without negatively impacting QoE, still remains to be proven. Providers of network testing solutions must also follow the NFV evolution closely in order to provide applicable and relevant testing solutions and reap the benefits of the NFV wave on the horizon. Besides being NFV compliant, test tools must also address the new challenges stemming from the transition of networks to NFV, namely interworking, media processing and QoS to name a few.

EXFO's Virtual QualityAssurer (vQA) delivers the best of both worlds with traditional hardware accelerated user plane and new software-based control plane testing, resulting in high performance test traffic generation and extremely accurate real-time analysis. Now manufacturers and operators are empowered by a solution to comprehensively and confidently test their NFV offerings. vQA can be deployed in OpenStack- or VMware-based cloud environments. It maintains the flexibility and user-plane performance that has traditionally set apart our QualityAssurer product line from the competition, while introducing new automation capabilities based on RESTful APIs.

vQA was engineered to empower manufacturers and operators to stress test VNFs and NFV-based networks. VNF lifecycle aspects such as elasticity and mobility can specifically be targeted for testing. NFV-specific challenges such as interworking, stability, media processing, service chaining and network slicing can be verified under real-world conditions, to make sure they are ready for prime time.

TRAFFIC MODELING

Accurately replicating live network conditions is a cornerstone requirement for any trust-worthy testing strategy. Every scenario and traffic condition that could occur in a live network must be simulated before a system is considered ready for deployment. This becomes particularly important for NFV deployments due to the elasticity aspect. One of the key benefits of NFV is the ability of the network to scale up and down based on traffic conditions. This ensures efficient use of resources and is a key contributor to NFV's promised cost savings. However, from a subscriber QoE point of view, this scaling must be completely transparent. The instantiation of a new instance or the termination of an instance should have no negative impact on service delivery or subscriber experience.

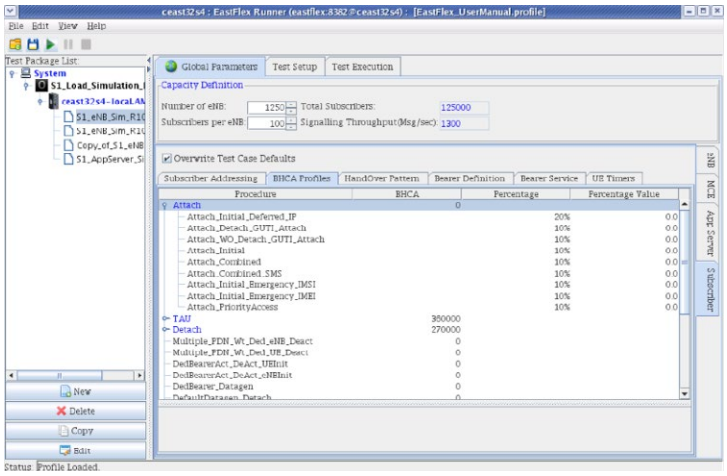


Figure 1. Traffic modelling

vQA provides powerful traffic shaping capabilities that allow high fidelity recreation of live network traffic patterns including:

- Granular control for both control and user plane traffic
- Ability to specify BHCA values for individual procedures and their variants
- Control over the percentage mix of different types of user plane traffic including HTTP, video and VoLTE
- Vary traffic patterns and load over time to recreate (for example) time-of-day traffic variations
- Recreation of special conditions to stress test networks in unexpected ways. (e.g., attach storms)

This level of granular control on traffic patterns makes vQA the ideal solution for testing network slicing as well. vQA can be configured to generate traffic configured and fine tuned to specific network slices. For instance, vQA could simulate millions of MBB subscribers generating video streaming, social network activity, web browsing and other such traffic in order to test a network slice dedicated to MBB applications. At the same time, it could simulate millions of NB-IoT devices and generate IoT traffic towards a network slice dedicated to NB-IoT.

FLEXIBILITY

At its inception, any new technology has a period of evolution when standards are being finalized, products are evolving, new ideas are being tried and trials are being conducted. We are at such a stage now with NFV, IoT and 5G. During such a dynamic period of a technology's lifecycle, testing obviously plays a critical role. However, one aspect of the test solution is key–and that is flexibility. Since standards, use cases and products have not yet stabilized, and many new things are being tried, test tools must have the capability to quickly adapt to unforeseen requirements. This requires extreme flexibility in several areas:

- Call flow definitions
- Protocol layer–message template definitions
- Traffic and subscriber modeling
- Pass/fail based on user-defined criteria and thresholds
- Reporting–stats and KPIs

Through intuitive graphical editors, vQA gives users full control over call flows and message templates. This empowers users to address any testing requirements without being dependant on the test tool vendor. For instance, an issue seen in the field during a trial could be quickly reproduced in the lab. Or a different interpretation of the spec by a vendor could be rapidly incorporated into the testing plan. Users can control success/failure criteria through control over the call flow logic as well as by specifying threshold values for KPIs.

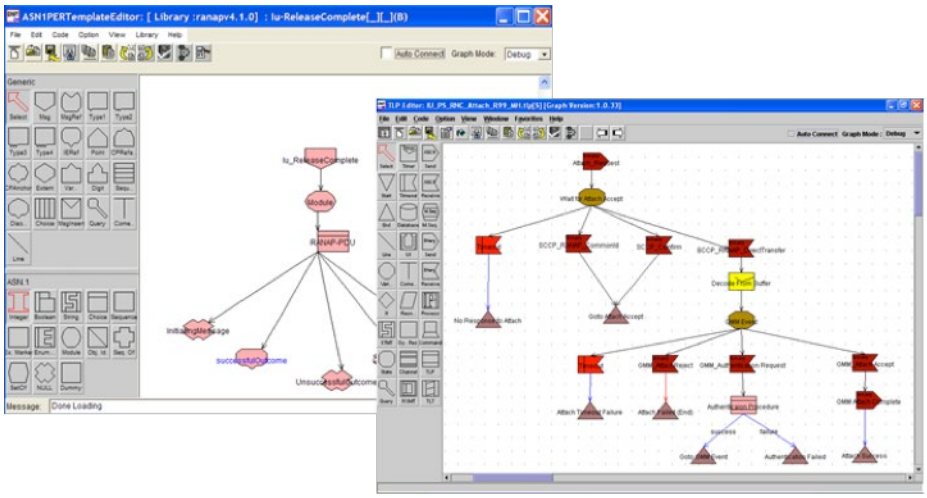


Figure 2. Extreme flexibility through graphical editors

vQA's SmartReplay feature provides users with the flexibility to introduce new user-plane flows into the traffic mix. From a single PCAP capture, a new flow can be easily imported into the system. With graphical editors, users can customize the imported flows if needed.

AUTOMATION

Automation is one of the ways to realize the cost savings benefits of NFV. vQA has extensive support for test automation including support for traditional CLI-based automation and more relevant RESTful API-based automation. Automation capabilities enable:

- Execution of test profiles
- Monitoring of the tests executed
- Return of test results

TEST CONFIGURATIONS

vQA supports a wide range of test configurations within and across 2G/3G/4G/4G wireless networks as well as IMS. Possibilities range from testing the entire network end to end, isolating individual elements (PNF or VNF) or anything in between. Depending on the system under test (SUT), vQA can simulate the rest of the relevant elements using test VNFs. With these test configurations, relevant services can be tested such as VoLTE, ViLTE, WebRTC, RCS, IoT and MBB. Some of the most common configurations are listed below (see Table 1), indicating the SUT and which test-VNFs are used for simulating subscribers and other network functions.

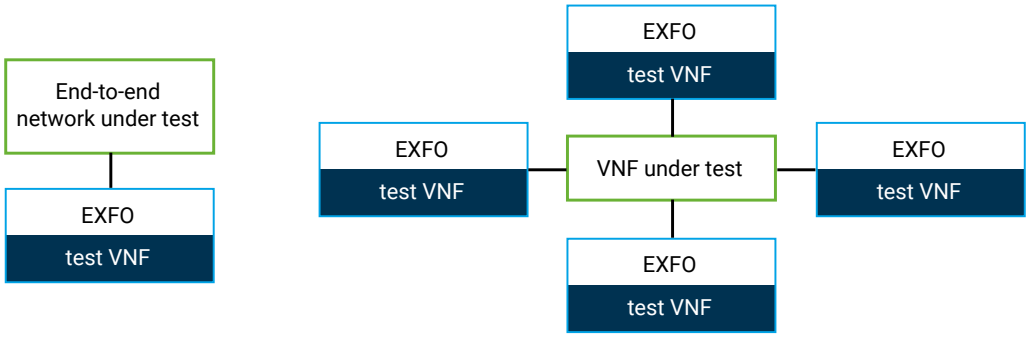


Figure 3. Test configurations

Some of the most common configurations are listed below, indicating the SUT and which test-VNFs are used for simulating subscribers and other network functions.

SYSTEM UNDER TEST (SUT)	TEST-VNFS
IMS	SIP/VoLTE endpoints, PCRF, HSS
SBC	SIP/VoLTE endpoints, PCRF, HSS, AS, IMS Core
EPC	eNBs, PCRF, CGF, SGSN, MSC
EPX+IMS	eNBs, VoLTE endpoints
MME	eNBs, HSS, SGW, MME, SGSN, MME
SGW	eNBs, MME, PGW, SGSN
PGW	SGW, PDN, PCRF, CGF
eNB	EPC, eNB

Table 1. Most common test configurations

NFV USE CASES

Primary use cases enabled by vQA, and most relevant to NFV testing, include:

- **Characterize the functional behavior, performance verification, benchmarking and dimensioning of the VNF.** Availability, retainability, quality, security and mobility can be quantified through KPIs reported by vQA. Some of the KPIs include: RRC/attach/registration success rates, UE context, bearer drop rates, attach/call setup/handover time, throughput, delay, tunnel setup rate and intra-LTE/iRAT handover success rates
- **Verify VNF management functions such as package and lifecycle management.** VNF lifecycle aspects such as onboarding, scaling, etc. are targeted for verification. The most complex and most pertinent to subscriber QoE is scaling in/out (elasticity) depending on traffic conditions. vQA is particularly well suited for this test, with its ability to finely tune generated traffic patterns
- **Characterize functional behavior, performance and reliability of network services such as VoLTE, ViLTE, RCS, etc.** Some relevant KPIs reported by vQA include voice quality measurements, packet loss, delay, jitter, throughput and network responsiveness
- **Verify management functions of the network service, such as descriptors and lifecycle management.** This includes verifying the correct operation of service chaining in same or different servers, same or different data centers, multitenancy and elasticity. KPIs of interest include VM/VNFC/VNF instantiation time, address assignment time, NS instantiation time and first/subsequent packet latency.

VQA ARCHITECTURE

vQA is comprised of the following key components:

virtual System Controller (vSC)

The vSC is the central point of control and manages applications running on the vQA system.

virtual Protocol Engine (vPE)

Referred to as test-VNFs, vPE modules execute the various applications, such as SIP endpoints, eNBs and PCRF.

License manager

A centralized license manager is deployed to manage the use of available features, capacity and performance among multiple users.

The vSC and vPEs can be deployed in different configurations depending on the environment, size and complexity of the test requirements.

Figure 4 illustrates the vQA architecture as described below.

- The vSC and vPEs are deployed on independent virtual machines (VM).
- One vSC can manage multiple vPEs
- The system can be scaled by deploying additional vPEs
- OpenStack deployments can be single-node or multi-node
- Users VNC into vSC
- Option to use PCI passthrough and SR-IOV to optimize performance
- HEAT templates for typical configurations
- Utility to create custom HEAT templates

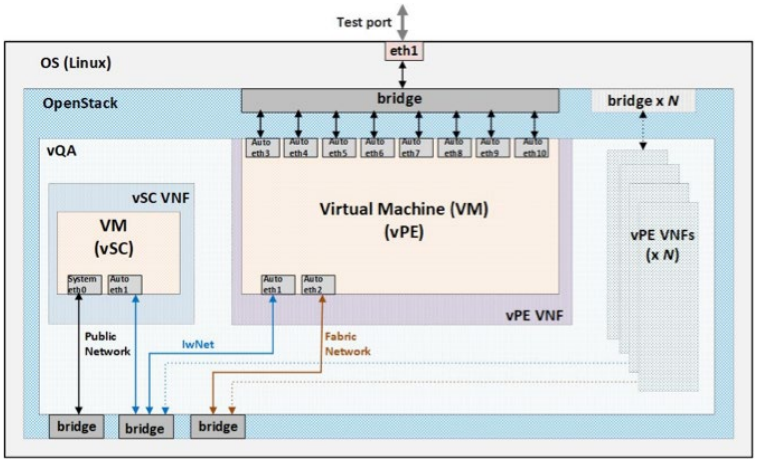


Figure 4. vQA architecture

LICENSE SERVER

A license server manages which features are enabled within a particular vQA deployment. It also controls the performance and capacity limits of the vQA deployment. For example, vQA's license server controls the number of subscribers simulated and VoLTE calls/sec that can be generated. Figure 5 depicts the deployment of a license server. The benefits of vQA's license server are outlined below.

- Licensing strategy designed to be flexible and scalable
- Enabling effortless sharing of licenses among multiple users
- Users can checkout and check-in performance and capacity licenses as needed
- Licenses related to interfaces and features, if enabled, are available to all users

The items controlled via licensing broadly fall under two categories: test-VNF specific and test-VNF agnostic(global). Global items include such things as number of users and IPSec. Test-VNF specific items include performance, capacity, interfaces and other features relevant only to that test-VNF.

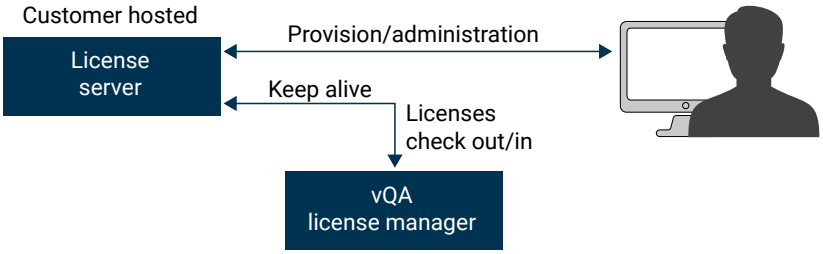


Figure 5. License management

SPECIFICATIONS	
Max vPEs per vQA	16
Max test vNICs per vPE	8
Max users per vQA	16
Platform compatibility	VMware 6.0/6.5 OpenStack: Newton, Ocata, Pike
Hypervisor	KVM ESXi v6.0 and v6.5
Guest OS	Software derived from the source code for the CentOS distribution
vSwitch	ovs-vsctl (Open vSwitch) 2.6.1
Persistent Storage	NFS file system
Distribution	VMware: OVF, VMDK, RPM OpenStack: QCOW2, RPM, HEAT templates

SYSTEM REQUIREMENTS	virtual License Server (vLS)	virtual System Controller (vSC)	virtual Protocol Engine (vPE) (typical)
CPU	2.4 GHz or higher	2.4 GHz or higher	2.4 GHz or higher
Cores	1 physical core	2 physical cores	1 (min) to 9 (max) physical cores
RAM	4 GB	8 GB	4 GB (min) to 32 GB (max)
vNICs	1	2	3 management vNICs 1 (min) to 8 (max) test vNICs
HDD	20 GB or higher	20 GB or higher	20 GB or higher

Notes:

- Hyper-threading is assumed.
- The VM requirements for vPE in terms of cores, RAM and vNICs depend on the specific test-VNF being deployed and the performance and capacity requirements. The following table gives performance and capacity numbers for different test-VNFs per physical core with 1 vNIC:

TEST-NFV	PERFORMANCE	CAPACITY	RAM
SIP Endpoints	4000 regs/sec [a], 1200 cps [b]	256 K	4 GB
VoLTE Endpoints	370 cps [b]	256 K	4 GB
eNBs/UEs – S1	6600 msgs/sec	79 K UEs and 2133 eNBs	6 GB
HSS – S6a	1650 msgs/sec	875 K subs	4 GB
MME – S10	6000 msgs/sec	125 K subs	8 GB
SGW/PGW – S5	9750 msgs/sec	2.56 M	8 GB
PCRF	3600 txns/sec	512 K	4 GB
Charging Function	3600 txns/sec	512 K	4 GB
Application Server	104 cps	128 K	4 GB
SIP PS	2050 rps	2 M	4 GB
P/S/I-CSCF	720/810/1100 regs/sec [a]	128 K	4 GB

a. UDP, IPv4. Registrations without challenge.
b. Half calls

Notes:

- In addition to the number of cores based on the above table, every vPE requires one additional core for vSwitch and other overhead
- Two physical ports are needed for connectivity between the vPE and the user plane modules. Each user plane module has up to 8 X 1G and 2 X 10G ports.
- On VMware, the license manager must be deployed on a bare metal server. In an OpenStack environment, the license server can be deployed on a bare metal server or on a VM.

USER PLANE PERFORMANCE

vQA provides hardware accelerated generation and analysis of user plane traffic. It also supports software only data pass-through functionality for user plane traffic. The pass-through feature supports transferring data between clear mode and GTP tunnels.

PER PORT PERFORMANCE AND CAPACITY		
TCP generation and analysis	10 GB ports: • 19.6 Gbit/s (tx+rx) • 2M total bearers; 1M active	
RTP generation and analysis	10 GB ports: • 256 K RTP streams 1 GB ports: • 32 K RTP streams	Voice quality measurements based on e-model on each stream in real time
TCP pass-through	6 Gbit/s (UL+DL)	
UDP pass-through	8 Gbit/s (UL+DL)	

ORDERING INFORMATION

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