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TeraVM in CloudNFV – Test Data as a Service (TDaaS)

Solution Brief

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TeraVM in CloudNFV – Test Data as a Service

Shenick Network Systems (now an Aeroflex Company) was the first test and measurement integration partner in CloudNFV, in which TeraVM forms the basis of a CloudNFV "Test Data as a Service (TDaaS)" offering.
TeraVM is successfully integrated as a Virtual Network function (VNF) the OpenStack/KVM based CloudNFV environment. TeraVM is being used by other CloudNFV partners to showcase the overall viability and power of Network Functions Virtualization (NFV).

1 CloudNFV overview

CloudNFV is a data-model-driven implementation of Network Function Virtualization (NFV) based on a flexible software platform that provides considerable latitude in creating “virtual” databases from information collected from a wide variety of sources, including MIBs. This flexibility means that nearly any standard or open interface can be presented at any appropriate point with only minimal development.

The implementation of CloudNFV is running in Dell’s Solution Center in Santa Clara, California.

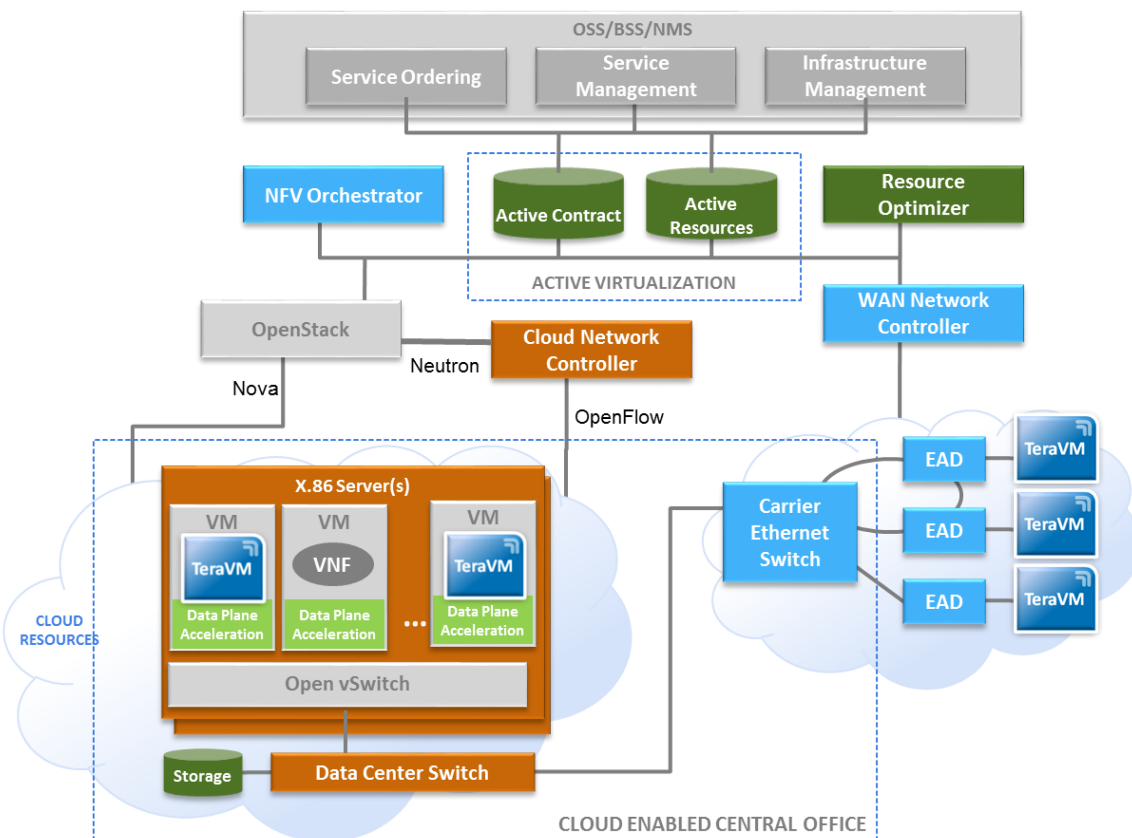

Figure 1: TeraVM in CloudNFV

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1.1 Service Models in CloudNFV

CloudNFV's goal is to validate the recommendations being put forward by the ETSI Industry Specification Group (ISG) for Network Function Virtualization (NFV). A key concept of the ISG is service models, in which a Service Provider has the ability to run Virtual Network Function (VNF) instances on NFV infrastructure which is operated by a third party.

CloudNFV demonstrates that the service model concept works and that the process can be simplified through a layer of abstraction. That is, that the services can be enabled by sending an instruction set from the management layer to a NFV orchestrator. The orchestrator manager in conjunction with a cloud operating system such as OpenStack results in the deployment and launch of the VNF and all of its required infrastructure.

CloudNFV demonstrates a number proof of concept services, which include: IMS as a Service, DPI-as a Service, Test Data as a Service (TDaaS), etc.

1.2 Test Data as a Service in CloudNFV

TDaaS enables users to validate two distinct elements: networking and service reliability. Launching TDaaS on its own enables basic network test and performance measurements. However, if TDaaS is included as a sub-service of a stateful service deployment such as IMS, it then becomes an active element in proving the robustness and reliability of the service being deployed.

1.3 TeraVM in CloudNFV

TeraVM is unique in CloudNFV as it enables a network test and performance measurement solution as a VNF, which is orchestrated and launched as per any other standard VNF. The core purpose and function is to emulate stateful traffic for testing, facilitating TDaaS. The simplicity in which the TeraVM VNF can be brought up on the CloudNFV platform demonstrates that CloudNFV is an open and inclusive platform, a key ideology for network function virtualization.

CloudNFV is host to a number of integration partner VNFs and with such a range of functions it's clear that for CloudNFV to produce purposeful data there is a need for a mix of real network application traffic. TeraVM as a virtualized IP test solution, provides emulation and performance

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measurement on a wide range of applications, making it an ideal candidate for testing the range of services such as IMS as a service or DPI as a service.

An additional benefit of using TeraVM is the ability to demonstrate the effectiveness of the CloudNFV architecture and active resource management policies to deal with real world scenarios.

For example the ability of the platform to elastically scale based on the resource utilization e.g. CPU utilization of a given service. Here TeraVM is used to test the accuracy of the elastic policy by emulating the level of application traffic necessary for the given VNF to trigger an event in the management system. The management layer then sets about orchestrating additional resources.

TeraVM as the active TDaaS utility can also be scaled up or down, delivering the level of traffic required to force the platform to expand and contract as needed, further verifying CloudNFV as an elastic cloud. With the presence of real application flows it makes it easier to answer key questions which include the effects that portability has to users of a service delivered over a VNF.

TeraVM's granular approach of per flow emulation and performance measurements are critical in accurately defining elasticity, scalability and portability performance in CloudNFV.

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2 CloudNFV Active Virtualization

CloudNFV has as its core three principles; deployment, management and optimization, which is what CloudNFV refers to as "Active Virtualization". In its simplest form the deployment process places emphasis on the principle that the VNF can be instantiated on standard cloud infrastructure and the management process proposes that the VNF be managed through a standard set of management interfaces/protocols.

At a high level this means that TeraVM, will be instantiated on to the cloud platform through an open infrastructure level orchestration and furthermore will have a conceptual model which can be used for policy management.

Once TeraVM is instantiated, CloudNFV management uses service templates of the active virtual network functions to create an inventory of available services, which for TeraVM means being seen as a "Test Data as a Service" entity in the management layer.

2.1 VNF modelling

In order to produce a service, a conceptual model for a VNF is required, the management and orchestration entity must understand the infrastructure architecture of the system to be deployed as a VNF. In relation to TeraVM, the architecture is relatively straight forward, it consists of two key components a controller and a test module interconnected via a virtual network. The TeraVM controller is a single compute instance which allows the user to configure and manage network tests which will run across a number of compute instances.

The following is an example of how TeraVM as a TDaaS can be modelled in terms of infrastructure requirements:

1) As indicated TeraVM's basic configuration consists of two types of virtual machine instances, one for controller (TVM-C) and a second for traffic generation (TVM). A single controller can manage multiple traffic generation modules. This modelling detail provides for the basic orchestration requirements in terms of the number of vCPU, disk space and memory.

   With two distinct virtual machines, TeraVM can easily scale in an elastic manner to meet the dynamic needs of the "Test Data as a Service" requirement.

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2) A further aspect of the modelling process is the networking requirement of the VNF. In the case of TeraVM the requirement is for a minimum of 3 networks:
   a. Management network: used to access the TVM-C. In terms of an OpenStack deployment the tendency is to associate a floating IP address so as to access the controller from outside the cloud.
   b. Communications network: a network dedicated to TeraVM components, this enables ease of use when scaling "Test Data as a Service"
   c. The target network for the traffic generated. Each traffic generation module can have up to 8 virtual interfaces which are defined before instantiating.

In defining the model for "Test Data as a Service" the target network is by far the most interesting and complex, due in part to its dynamic nature. Users of the service have the flexibility to define the target for the generated test traffic. This then triggers an event in which the management layer must orchestrate a network path between the two end-points.

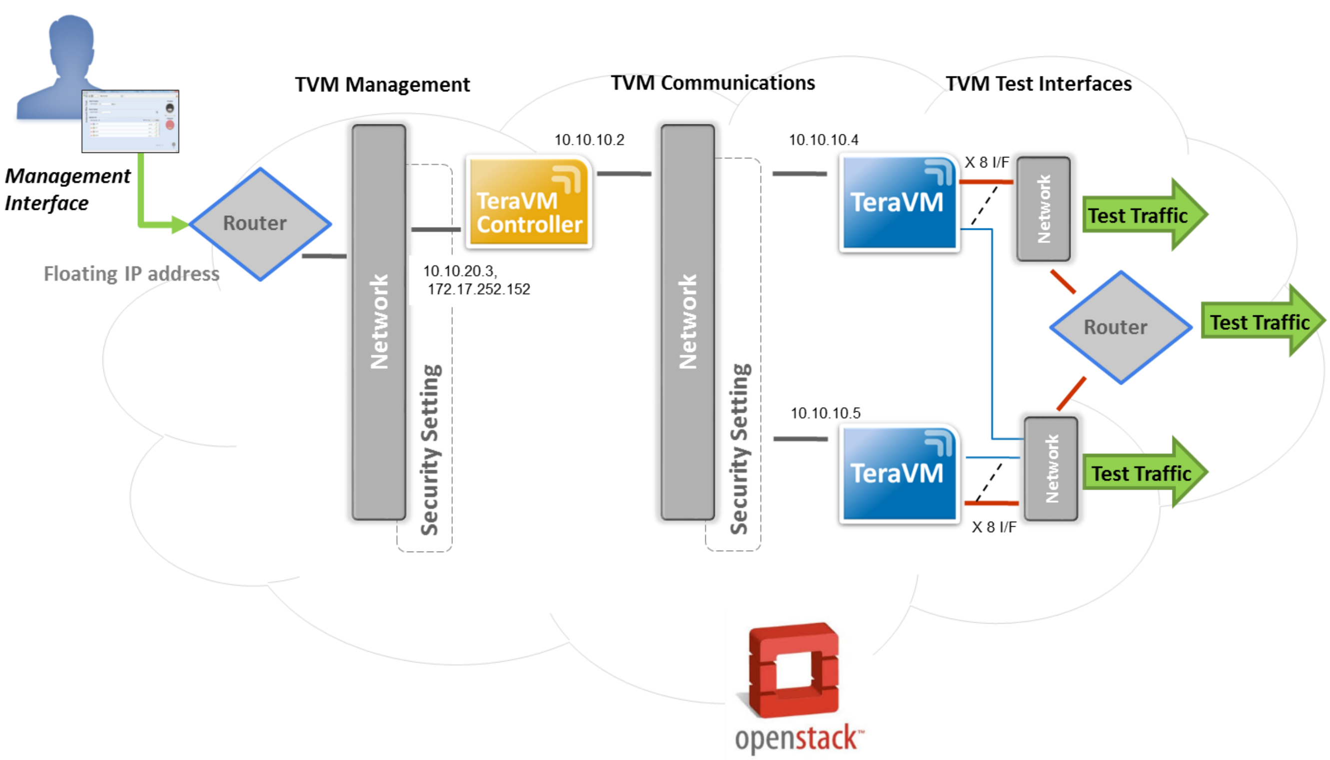

Figure 2: Example TeraVM deployment orchestrated with OpenStack

2.2 VNF management

Another of the three pillars to CloudNFV is the management process, which provides for active management of the infrastructure and VNFs. CloudNFV uses standard interfaces and applications to achieve this.

TeraVM supports CloudNFV's management process through standard web management and command line interfaces. TeraVM provides the management agent with general information on operations, which includes the number of test modules and test interfaces in use.

Active management of the TDaaS is achieved through the command line interface (CLI) in which a user can select and manage test runs as needed. Using TeraVM's problem flow isolation tools the feedback loop to the management agent is closed, providing event notifications when an application flow is experiencing difficulties.

The event notifications are then used to trigger an action in the VNF Management layer.

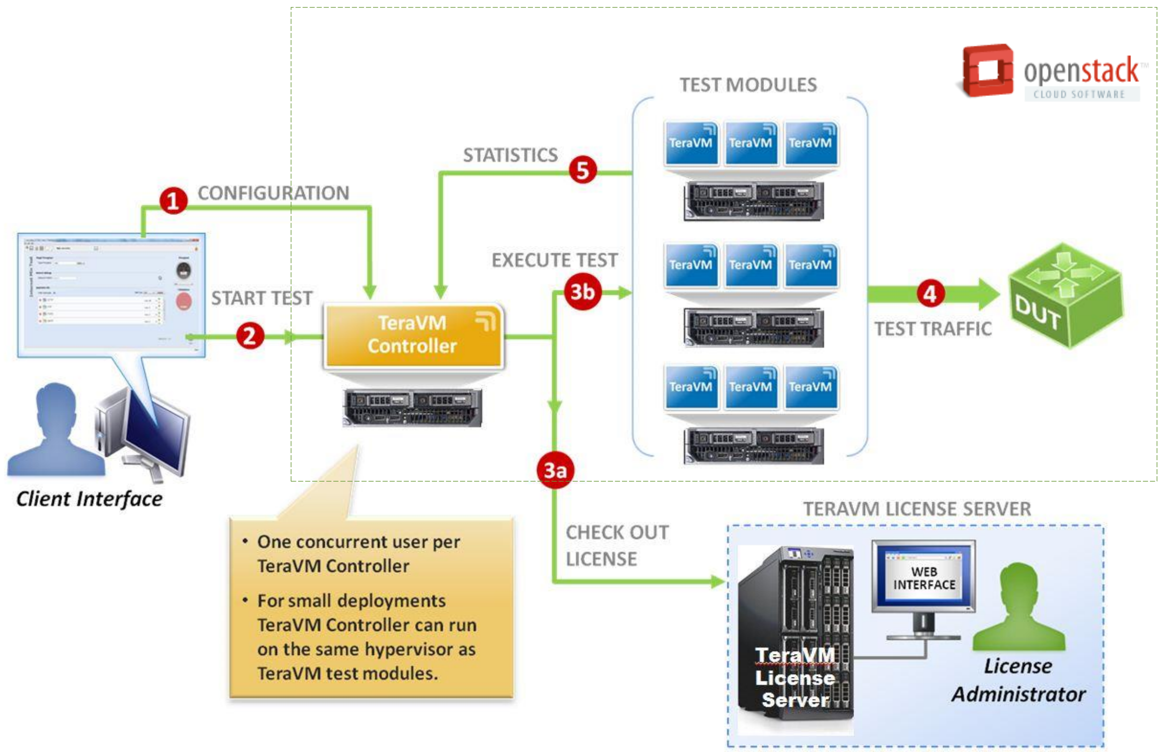

Figure 3: Example TeraVM user scenario

Figure 3 above highlights the steps required to use TeraVM in CloudNFV. The focus is to generate test traffic in the direction of the device under test (DUT). The steps are as follows:

1) Configure a test via the command line interface (CLI) on the TeraVM controller
2) Manage the test run by starting and/or stopping the test as needed
3) Test is executed by the controller:
    i) The controller checks out a run-time license
    ii) The test configuration is loaded and started on the TeraVM test modules
4) Test traffic is emulated in the direction of the DUT
5) Live performance analysis of all emulated traffic is available in the TeraVM controller
6) Event Notifications are generated in the management layer when a flow is experiencing poor quality

2.3 CloudNFV assessing traffic flow performance

Once the TeraVM test service is available, users can begin to configure or edit existing test cases as part of the “Test Data as a Service” in CloudNFV.

As an integrated emulation and performance measurement solution TeraVM provides in-depth analysis on each and every one of the emulated flows. TeraVM provides dedicated performance measurements for each application supported (i.e. download times for web pages, call setup times, voice and video quality, etc).

Application traffic flow performance can be assessed on per second intervals through regular polling of the TeraVM. The ability to determine performance in real-time enables the CloudNFV management layer to make decisions on live optimization requirements, the third pillar of CloudNFV’s architecture.

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3 Summary

CloudNFV is a partnership of leading industry figures and technology companies with a focus on network function virtualization. CloudNFV has a charter to show through a proof of concept that the recommendations being derived by the ETSI Industry Specification Group (ISG) for Network Function Virtualization (NFV) are viable, that deploying and operating virtual solutions is easy and that the performance of network functions have in no way been compromised by being virtualized.

In CloudNFV (hosted by Dell - Santa Clara, California), Shenick Network Systems (now an Aeroflex Company) was the first test and measurement integration partner in which TeraVM forms the basis of the CloudNFV "Test Data as a Service" (TDaaS).

CloudNFV is based around three principle pillars: Deployment, Management and Optimization processes. The ESTI ISG is not a standards body and as such CloudNFV has set out to implement an open and inclusive platform, using as much open standard software and interfaces. Deployment and orchestration of VNFs is done through OpenStack, which is one of the key reasons as to why TeraVM is the first test integration partner.

The ease in which the TeraVM VNF and other service VNFs can be integrated into the CloudNFV platform through the open cloud operating system, standard interfaces and protocols demonstrates that the core recommendations from the ETSI ISG are workable.

The ESTI ISG also recognizes that test and performance measurements are a critical component to realizing the successful adoption and rollout of virtual network functions (VNF). By including TDaaS as a base component in the NFV process, it's possible to show that the virtual networking infrastructure architecture is correct. But more importantly it's possible to verify the accuracy of any network based service level policy settings being put in place.

However, a key reason for using TeraVM as the TDaaS VNF is the ability to emulate stateful traffic flows. The simple fact is that the majority of VNFs when deployed are pretty much inactive i.e. using minimal resources: low CPU and memory utilization. However, to prove the capability of the VNF; requires users to run real application traffic flows against the VNF in order to exercise the virtual environment. This methodology of testing with real application flows further proves that the network function which is now being delivered as a software only component has in no way being compromised.

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However, a key benefit of the TeraVM VNF is the ability to test the performance of the scalability of the service VNFs. TeraVM like any other VNF is scalable and can be used to deliver increased volumes of application test traffic. As for the target VNFs, there should be a communication in the northbound application interface highlighting that utilization is high. This should signal to the VNF Management and Orchestration layer that there is a requirement to scale out or up the service VNF to deal with the increase in application traffic.

TeraVM as the TDaaS VNF in CloudNFV demonstrates the flexibility and openness of the NFV architecture, but is also helping to demonstrate that the network functions being delivered over software are as robust and as reliable, if not better, than that of the dedicated hardware counterpart.

Finally, the CloudNFV implementation showcases that NFV is a viable alternative in which to solve key service provider and carrier issues: such as network scaling, addition of new network nodes and most importantly a means in which to rapidly deploy services in an over the top application like manner and all within the restraints of reduced capital and operational expenditures.

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Dell provides world class compute, storage, and networking hardware and services for enterprises, carriers, institutions, and data centers. As a founding member of CloudNFV, and actively contributing in many open-standard industry forums, Dell develops and promotes open, standard, and compatible network and ICT solutions. These high quality top tier solutions leverage the massive scale and economies of well-established offerings and markets. With dedicated resources for Telecom and Data Center practices and a broad global footprint, Dell provides hardware, software, services, and support solutions for partners and customers around the world and works closely with Intel to bring high quality solutions to market.

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CHINA Beijing
Tel: [+86] (10) 6539 1166
Fax: [+86] (10) 6539 1778

CHINA Shanghai
Tel: [+86] 21 2028 3588
Fax: [+86] 21 2028 3558

CHINA Shenzhen
Tel: [+86] (755) 3301 9358
Fax: [+86] (755) 3301 9356

FINLAND
Tel: [+358] (9) 2709 5541
Fax: [+358] (9) 804 2441

FRANCE
Tel: [+33] 1 60 79 96 00
Fax: [+33] 1 60 77 69 22

GERMANY
Tel: [+49] 89 99641 0
Fax: [+49] 89 99641 160

INDIA
Tel: [+91] 80 [4] 115 4501
Fax: [+91] 80 [4] 115 4502

JAPAN
Tel: [+81] (3) 3500 5591
Fax: [+81] (3) 3500 5592

KOREA
Tel: [+82] (2) 3424 2719
Fax: [+82] (2) 3424 8620

SCANDINAVIA
Tel: [+45] 9614 0045
Fax: [+45] 9614 0047

SINGAPORE
Tel: [+65] 6873 0991
Fax: [+65] 6873 0992

TAIWAN
Tel: [+886] 3 5500 338
Fax: [+886] 3 5502 065

UK Stevenage
Tel: [+44] (0) 1438 742200
Fax: [+44] (0) 1438 727601
Freephone: 0800 282388

USA
Tel: [+1] (408) 385 7630

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www.aeroflex.com
info-test@aeroflex.com

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