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Titanium Cloud vs. “Vanilla” OpenStack: Comparative Performance Analysis of GENBAND Advanced Media Software VNF

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EXECUTIVE SUMMARY

Network Functions Virtualization (NFV) promises lower costs and greater flexibility in the way that communications service providers (CSPs) build networks and deliver services. By decoupling network functions from dedicated appliances and implementing them as virtual functions on standard industry servers, CSPs will benefit from lower-cost hardware and the ability to introduce new services more quickly and scale services more flexibly.

But in the transition to network virtualization, CSPs need to deliver services with the same—or better—carrier grade reliability and performance as they have on their traditional hardware-based networks. Doubts about NFV's carrier grade capabilities have lingered among CSPs since the concept was first introduced in 2012. After all, IT-grade systems and open source software do not meet telco requirements. Without carrier grade performance, the full cost saving and service agility benefits cannot be achieved.

A key factor in determining performance of NFV-based services is the inner workings of the NFV infrastructure (NFVI)—namely, the cloud management software that orchestrates the virtual machines (VMs). One of the leading options for this function is OpenStack. But as an open source software project, OpenStack was not designed for carrier grade networks.

Open source software and IT-grade servers are fundamental to the flexibility, agility, and cost savings of NFV. To realize these benefits in full, the open source software needs to be hardened and optimized to deliver carrier grade performance and reliability.

To show the performance difference between "vanilla" (i.e., unmodified) open source and an optimized open source solution, two different OpenStack Neutron networking implementations were put to the test with the GENBAND Advanced Media Software (AMS) virtual network function (VNF). This paper examines the comparative performance for processing real-time media workloads using the GENBAND AMS VNF with vanilla OpenStack in one cloud environment and the OpenStack-optimized Wind River® Titanium Cloud™ virtualization software in another environment. The results show how the total cost of ownership (TCO) in CSP data centers can be greatly reduced by optimizing media processing.

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GENBAND AMS VNF

The AMS VNF provides virtual media processing functions that transcode media packets and provide media protocol interworking for IP-based real-time communication services, from voice to video to myriad collaboration applications. This function was traditionally performed by proprietary hardware appliances. It is a vital function for most real-time communication services and requires high performance from the NFV cloud environment.

TITANIUM CLOUD VS. VANILLA OPENSTACK TEST DESCRIPTION

GENBAND's AMS VNF was deployed in two different cloud environments. In the first instance, the AMS VNF was running on a vanilla OpenStack (Liberty release), environment using standard, non-accelerated Open vSwitch (OVS). In the second setup, AMS was running in Titanium Cloud, which features an optimized OpenStack (Kilo release at the time of this test), with integrated accelerated virtual switch (AVS) based on the Data Plane Development Kit (DPDK).

The test simulated call loads to each environment using GENBAND's SIP call generator to represent pass-through media processing with no transcoding. The test generated 200 call sessions in the vanilla OpenStack environment and 3,000 call sessions in the Titanium Cloud environment, which required four separate load generators, each running at 750 sessions. For this test, the call duration time parameters were not relevant.

The hardware and software components involved in the test included the following:

Hardware

- HP ProLiant DL160 Gen9 servers
- Dell PowerEdge R630 Haswell class rack servers
- Dell S4820T 10G switches

Software

- Wind River Titanium Cloud R15.12
- Vanilla OpenStack Liberty release
- KVM hypervisor
- GENBAND Advanced Media Software VNF, comprising multiple VMs that perform management, media gateway control, packet processing, and software-based transcoding

TEST RESULTS: TITANIUM CLOUD OUTPERFORMS VANILLA OPENSTACK

The comparative analysis of the two cloud environments measured call load, packet loss, CPU utilization, and the amount of CPU cycles required for each stage of processing. The basic work flow for the test demonstration comprised three stages: packets were received (Rx packets), then processed within Real-Time Transport Protocol (RTP) frames, and then the packets were transmitted out (Tx packets).

The metrics were collected in real time by the iMedia component of the GENBAND AMS VNF and displayed in dashboards leveraging representational state transfer (REST) application programming interfaces (APIs) within the VNF Manager. This unique real-time measurement capability of GENBAND's VNF and VNF Manager are important features for monitoring system performance and, significantly, do not impair the performance of AMS in any way.

The vanilla OpenStack environment processed 200 calls and the Titanium Cloud environment handled 3,000 calls. The difference in CPU utilization was significant between the two environments. In the vanilla environment, CPU utilization was 12% while 60,000 packets were being processed. And in Titanium Cloud, CPU utilization was substantially lower at 3% while it processed nearly 400,000 packets. During the course of the demonstration, CPU utilization in Titanium Cloud stabilized at a steady 11%, but the utilization in OpenStack was not as consistent and frequently spiked.

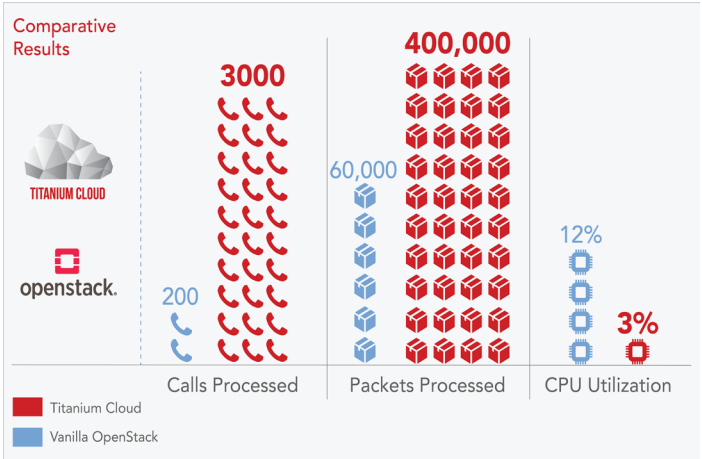

Figure 1. Vanilla OpenStack vs. Titanium Cloud

The vanilla OpenStack environment experienced packet loss on the egress where Tx packets were dropped, but there was no Rx packet loss, indicating that the system was not able to keep up with the workload. In Titanium Cloud, there was no packet loss at all.

The inconsistent CPU utilization in OpenStack is related to the Tx packet loss. The spikes in CPU utilization show that the system was spinning harder to transmit packets that had been backed up in a queue and unable to transmit.

Looking at the results for how many CPU cycles each environment used for different processing tasks, there was also a striking difference. Typically, transmitting packets requires the least amount of processing work because it is simply a packet queuing task. More work is involved in receiving packets due to load balancing and other functions that are needed. And the bulk of the CPU cycles are usually taken up by processing the packets within the system. In a well-behaved cloud environment, CPU cycles would be consumed by each task accordingly.

But in the test demonstration, the transmit function in the OpenStack environment took up more than 15,000 CPU cycles, while in Titanium Cloud it only took a few hundred. At the same time, the receive and processing functions used the same amount of CPU cycles in both environments. The results suggest a bottleneck in the vanilla environment for transmitting packets, which caused the large CPU spikes and dropped transmit packets.

Putting all the results together, Titanium Cloud achieved a 15-fold performance improvement, processing 3,000 calls compared to vanilla OpenStack processing 200 calls with 11% CPU utilization; it also delivered better call quality.

TITANIUM CLOUD MAXIMIZES GENBAND AMS VNF PERFORMANCE

As the test demonstration shows, the performance of GENBAND's AMS VNF was far higher on Titanium Cloud with integrated AVS than in the OpenStack/OVS environment. The VNF processed 15 times more call sessions with consistently low CPU utilization and no packet loss.

Titanium Cloud virtualization software is built on open source software components—including Ceph, KVM, Linux, and OpenStack—that have been hardened and optimized to deliver services with carrier grade reliability and high performance. The DPDK-based AVS uses fewer CPU cores than any other vSwitch. That means more CPU cores are available for running more VMs. Greater VM density directly results in lower operating costs for CSPs because they can run more VNFs and serve more customers per server.

Titanium Cloud also ensures 99.9999% (six nines) reliability, which translates into about 30 seconds of downtime per year. Unlike IT-grade systems, Titanium Cloud delivers guaranteed uptime as well as security that meet telco standards. Carrier grade reliability protects service revenue by enabling CSPs to meet service level agreements (SLAs) and regulatory obligations.

For CSPs delivering real-time media services like Voice over LTE (VoLTE) via GENBAND's AMS VNF, the TCO in core network and edge data centers can be reduced by more than 50% by optimizing media processing and transcoding performance with Titanium Cloud virtualization software.

CONCLUSION

While OpenStack is a critical enabler for NFV, the open source software alone is not enough to deliver the promise of cost savings and service agility. By optimizing OpenStack through plugins and extensions, the open source software can indeed deliver the performance that CSPs require. Titanium Cloud virtualization software runs virtual functions with carrier grade reliability and accelerates the performance of VNFs to maximize operating cost savings.

Titanium Cloud's performance directly translates into real business benefits for CSPs, including protected service revenue, lower operating costs, as well as the flexibility to deploy services quickly and scale services dynamically. In the specific case of real-time media processing, which enables a wealth of IP-based communication services, GENBAND's AMS VNF achieved 15 times better performance running on Titanium Cloud compared to vanilla OpenStack. The optimized media processing will contribute to a TCO reduction of more than 50% in CSP data centers. Through hardened open source software, Titanium Cloud delivers on the promise of NFV.

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