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Performance of OpenVSwitch Bridge Network in Virtual Cloud Environment

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Abstract. Cloud computing is the topic of the fastest growing area in the world of information and communication technology today. In order to provide cost-effective infrastructure services that include compute and storage services by cloud service providers, it is important to provide efficient compute, storage, and network virtualization so that these resources can be maximally shared across a large number of tenants in a massive multi-tenant cloud environment. Virtualization technology acts as the backbone of Cloud Computing for virtualization of compute, storage, and network resources that are delivered as services over the network. OpenVSwitch is a multi-tier standard software defined networking (SDN) switch based on the Apache 2.0 open source license. OpenVSwitch works at layer 3 of the OSI protocol in contrast to linux bridge which works at layer 2 of the OSI protocol. This study measures the performance of the OpenVSwitch SDN Switch in a virtual cloud environment. The performance meters measured include TCP upstream, TCP downstream, UDP upstream and UDP downstream. The performance measurement results are compared with the linux bridge performance on the same parameters. The performance measurement results show that there is a slight difference in the performance of OpenVSwitch and Linux Bridge.

1. Intoduction

Cloud computing is the topic of the fastest growing area in the world of information and communication technology today. In order to provide cost-effective infrastructure services that include compute and storage services by cloud service providers, it is important to provide efficient computing, storage, and network virtualization so that these resources can be maximally shared across a large number of tenants in a massive multi-tenant cloud environment [1].

Virtualization technology acts as the backbone of Cloud Computing for virtualization of computing, storage, and network resources that are delivered as services over the network [2]. Virtual network management is a basic component provided by cloud computing systems. In a cloud environment, the fact that VMs on the same subnet are located on different hosts, VM traffic attached to different users must be isolated, VMs will be migrated to other hosts makes network management different from those on the physical network. Technologies such as overlays and Software Defined Networking (SDN) are usually introduced to build reliable and efficient virtual network management schemes. However, there are many disadvantages such as flexibility and cost of hardware in most of the schemes introducing the technology mentioned above[3].

Virtualization allow multiple operating systems to run within virtual machine running on sam hardware. Virtual machine manager (VMM) allocates resources from hardware for virtual machines. The oter name for VMM is hypervisors and main task of hypervisor is to allocate resources from

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hardware to run several virtual machines simultaneously. Each virtual machine represents physical device. Multiple virtual machines can run on same hardware while each VM can run spesific operating system. performance of virtual machine dependeable on factor like CPU, memory, hard disk etc[4].

Computer networks are becoming increasingly complex and require high investment in line with the development of cloud computing infrastructure. In addition, the management of network devices in a large network scale is quite difficult and becomes complicated in heterogeneous network environments where network devices are adopted from different manufacturers. Software Defined Networking (SDN) is a new technology that defines traditional computer network architectures. As the name suggests, in SDN the network is defined, managed and controlled via a programmable interface such as computer software; thus, it allows the network to dynamically change its topology, characteristics and increase or decrease it as needed.

Software switch has emerged as a critical component in software defined networking and network virtualization areas[5]. Open vSwitch (OvS) is a widely used software switch which uses tuple space search algorithm for packet classification, and an exact match cache (EMC) for caching most frequently used flow. In this research hypervisor proxmox is used to create virtual environment. Linux Bridge (LB) and OpenVSwitch are virtual switches used in proxmox hypervisor. The aim of this study is to measure LB and OVS performance in virtual environment.

2. Method

The test was carried out on the Proxmox hypervisor, which was installed on a computer with an Intel Core i7 processor, 8GB RAM and 140GB SSD. The Linux bridge and the OVS bridge are used interchangeably. In the Proxmox hypervisor, a container-based guest operating system is created using Linux Container (LXC). Linux-based containers were chosen because they use less resources than virtual machines. The guest operating system used is Linux Ubuntu 16.04. The system test topology is shown in Fig 1. IP address distribution is shown in Table 1.

Testing is done by sending TCP and UDP packet from the client to the server. Package delivery is done using the iperf software. VM1 and VM2 are connected using a Linux Bridge network, while VM3 and VM4 are connected using an OVS Bridge network.

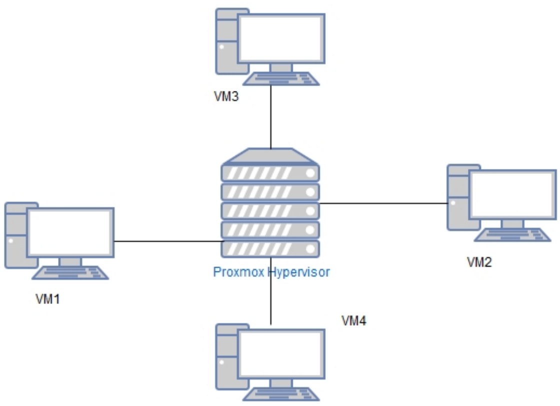

Figure 1. System under test

Table 1. Given IP Address

No	Machine Name	IP Address
1	Proxmox Hypervisor	10.10.1.98
2	Virtual Machine 1	10.10.1.99
3	Virtual Machine 2	10.10.1.101
4	Virtual Machine 3	10.10.1.40
5	Virtual Machine 4	10.10.1.70

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3. Result and Discussion

The test results of linux bridge using the TCP protocol are shown in Figure 2. The highest performance is achieved when the server uses 2 CPU cores and 1024 MB RAM. While the lowest results are achieved when the server uses 2 cpu cores and 512 MB RAM.

Figure 2. Performance of Linux Bridge measured using TCP protocol

The test results of OVS bridge using the TCP protocol are shown in Figure 3. The highest performance is achieved when the server uses 1 CPU cores and 512 MB RAM. While the lowest results are achieved when the server uses 2 cpu cores and 1024 MB RAM. According to [6], assigning more cores to the vSwitch results in better performance in case the number of cores required by the whole chain (VMs + vSwitch) does not exceed the number of cores of the server. When this happens, performance degrades until becoming unsustainable with 8 chained VMs. In fact, at this point some cores are shared among many polling threads and, for instance, it may happen that the operating system assigns the CPU to a VNF with no traffic to be processed, penalizing others that would actually have work to do.

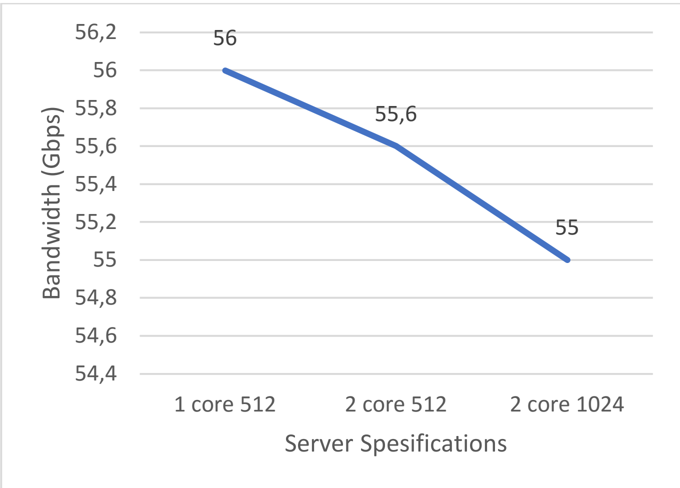

Figure 3. Performance of OVS Bridge measured using TCP Protocol

The highest throughput value for linux bridge is 55.1 Gbps while for OVS the highest throughput value is 56Gbps. It can be said that OVS has better performance than the Linux bridge on the TCP protocol.

In measuring network performance using the UDP protocol, both linux bridge and OVS bridge get the same results, namely 101 Gbps as shown in Figure 4 and Figure 5. According to [7], OVS-DPDK in container et the better performance compare with OVS-DPDK in host.

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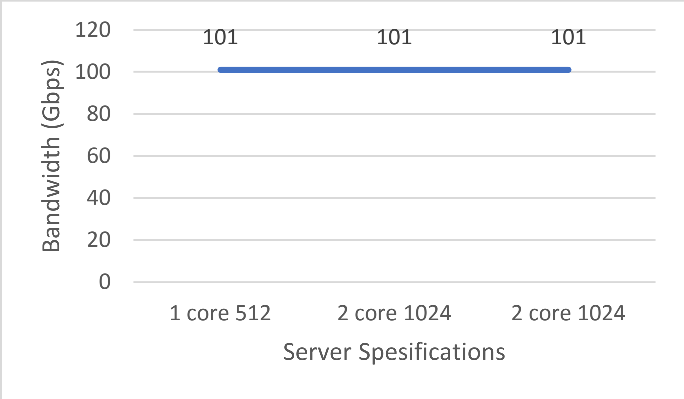

Figure 4. Performance of Linux Bridge measured using UDP Protocol

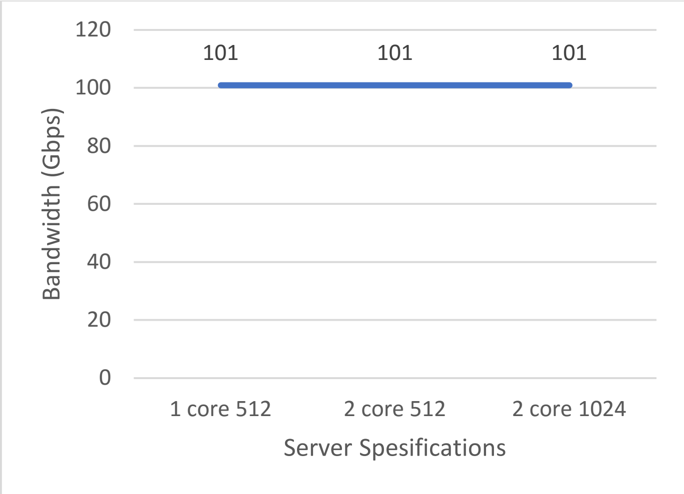

Figure 5. Performance of OVS Bridge measured by UDP protocol

According to [8] increasing the RAM size did not have a significant effect on the delay a packet experiences inside the OVS in the experiments we ran. This is the same as the experimental results that the addition of RAM does not automatically increase the throughput as shown in Figure 3. When the RAM increases to 1024 MB, the throughput value actually decreases compared to when the RAM is 512 MB. Compare with hardware-based switch, software-based switch still has less performance[9]. Overall ovs bridge has better performance than linux bridge. This is in accordance with the results of the research [10] which states that OVS showed good performance when compared to other Linux kernel for- warding techniques.

3. Conclussion

Hypervisors need the ability to bridge traffic between VMs and with the outside world. On Linux-based hypervisors, this used to mean using the built-in L2 switch (the Linux bridge), which is fast and reliable. So, it is reasonable to ask why Open vSwitch is used. The answer is that Open vSwitch is targeted at multi-server virtualization deployments, a landscape for which the previous stack is not well suited. These environments are often characterized by highly dynamic end-points, the maintenance of logical abstractions, and (sometimes) integration with or offloading to special purpose switching hardware.

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