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Performance Analysing for Virtual Router on Xen Hypervisor

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Abstract

The importance of virtual router has generated wide interest in future Internet because of advantages of virtualization such as flexibility and scalability. This paper builds a virtual router on Xen hypervisor. We measure the packet forwarding rate of the virtual router for comparing it with current Linux router, and analyze profiling result. The performance result shows that the virtual router provides better performance than native Linux router, and profiling result appears Xen function can reduce overhead of existing kernel function.

Keywords: Virtualization, Xen, SR-IOV, Virtual Network, Virtual Router, etc.

1. Introduction

Recently the Internet meets a variety challenges such as flexibility and scalability, but the current Internet is not enough to apply them. For covering these issues, network virtualization has been proposed as a new technique for the future Internet. [1] It allows coexistence of multiple network environments by using separated virtual machines. To perform the network virtualization, virtual router is a key element because of advantages such as low cost and programmability.

So, we build a virtual router based on Xen [2] that is a virtualization platform providing para-virtualized domain and open source. In addition, the virtual router reduces virtualization overhead with SR-IOV [3]. A goal of this paper is to analyse performance of virtual router. We compare a virtual router based on Xen with native Linux software router, and find causes why the virtual router is better than native Linux software router by profiling them.

2. Analyzing by Packet Forwarding

The hardware configuration is that a router machine uses Intel Xeon X5650 2.67GHz processor, 12GB of memory, and Intel 82599 10Gb NIC (2 ports) supporting SR-IOV. The hardware specification of sender and receiver is composed by Intel Core i7 3930K processor, 4GB of memory, and 10G NIC same as the router machine. A Xen virtual machine is configured with 1 virtual CPU, 3GB of memory, and 10G virtual NIC. To perform network topology, sender and receiver attach directly with the router machine. Sender generates 64B packets with 14.8Mpps sending rate during 200sec. Packets are transmitted to virtual router executed on Xen, and the virtual router performs routing and forwards packets to receiver. Receiver captures packets and measures packet rates (packets per second). Profiling uses Xenoprofile [5] for Xen and Oprofile [4] for native Linux. It checks CPU usage by counting CPU CLOCK samples.

The result is on Table 1 that shows performance. Virtual router in Xen-DomU can directly access to NIC by using virtual function [3] (ixgbevf-2.0.0) which shares one or more physical resources (port). The physical function [3] (ixgbe-3.10.17) in Xen-Dom0 also provides connection to NIC, and is used to configure and manage the functionality, such as enabling virtualization and exposing virtual functions. Additionally, Xen-Dom0 manages Xen-DomU. Native Linux uses basic Linux router (ixgbe-3.10.17). The forwarding rate of native Linux is 184,530pps. Xen-Dom0 shows lower rate than native Linux. On the other hand, Xen-DomU records 3.5 times higher rate than native Linux. All of these are executed on 1 CPU, because basic Linux router does not use multi-core. So, CPU utilization of them is all 100%. Virtual router shows a good performance in packet forwarding.

Figure 1 appears result about profiling. Each graph bar is characterized how many CPU resources use. Each graph bars are as follows: KERNEL is about scheduling, syscall, locking, and so on, MEM is memory work, NET is Linux network stack, and Xen is virtualization part. IXGBE is about SR-IOV NIC driver which is one of the important parts for packet forwarding. First, Xen-Dom0's XEN occupies a high CPU use, so IXGBE and other function cannot use CPU resources enough. That's why Xen-Dom0 shows lowest forwarding rate. Second, Xen-DomU obtains best performance. Xen-DomU's XEN serves as several parts of MEM and KERNEL, and reduces their CPU use. Xen-DomU's total CPU use of XEN, NET, MEM and KERNEL is lower than Native Linux's one. So, Xen-DomU's IXGBE can use remaining CPU resources for performance rise.

	Forwarding rate (pps)	**CPU utilization (%)**
Xen-DomU	640,791	100
Xen-Dom0	27,620	100
native Linux	184,530	100

Table 1. Forwarding rate & CPU utilization

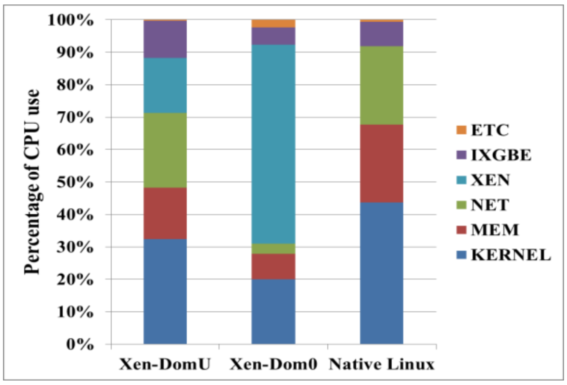

Figure 1. use of CPU resources

3. Conclusions

This paper presents a virtual router on Xen, and show its performance and reason why virtual router serves higher forwarding rate. Virtual router provides about 3.5 times higher forwarding rate than native Linux. Xen hypervisor reduce overhead of existing Linux kernel part, so virtual router on VM can use more CPU resources for forwarding.

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References

[1] N. Chowdhury, A survey of network virtualization, Computer Networks, Jan. 2010.
[2] Xen Hypervisor, http://www.xen.org/
[3] PCI-SIG SR-IOV Primer: An Introduction to SR-IOV Technology, http://www.intel.com/content/www/us/en/pci-express/pci-sig-sr-iov-primer-sr-iov-technology-paper.html
[4] Oprofile, http://oprofile.sourceforge.net
[5] Xenoprof, http://xenoprof.sourceforge.net