ABSTRACT

At present, the desktop cloud has come into people's life. You'll see them in some companies, offices, and school labs. The problem I am trying to solve in this paper is that because the computing power of virtual desktop is provided by the virtual machine, and then transmit data to the virtual desktop to display through the network, so compared with the traditional PC in terms of performance, there are still gaps, it is difficult to cope with the application of high load, such as 3D animation, high-definition video processing, etc. The approach I adopt to solve the problem is that we can use vfio-pci technology to direct GPU to a virtual machine, Enables the virtual machine to monopolize the graphics card, And be able to achieve more than 90% of the performance of graphics, This is a huge improvement for users, and many desktop cloud users are not limited to general enterprise applications, Such as Office, Web applications, Flash playback, video playback and so on. After pass-through, Users can carry out high load applications, 3D animation, high-definition video processing, etc. There are several companies doing virtualization, but KVM is an open source virtualization solution, its market share is not very high, KVM virtualization based on direct display card is not a mature scheme, this is another contribution to the open source.

Keywords: Openstack Cloud; KVM; Vfio-pci; GPU Passthrough with qemu

1. INTRODUCTION

Desktop cloud refers to access a cross platform application through a thin client or any other network connected device. The user's desktop environment is centrally deployed in the enterprise's data center, and the local terminal is only a display device. Desktop virtualization has a lot of disadvantages, this paper studies and analyses the main performance problems of the virtual desktop, because virtual card cannot complete the high load task, this paper focuses on how to achieve the transmission of GPU based on QEMU-VFIO.

2. Related Technology (Pass-through)

2.1 Fixed Pass-through

The fixed pass-through (fixed pass-through: A virtual machine using a GPU exclusively) is adopted in this article, enables virtual machines to use full performance of graphics cards.
2.2 Using VFIO mode to make GPU pass through in KVM/QEMU
VFIO is supported after Linux kernel 3.6/qemu 1.4 and only supports PCI devices currently. VFIO is a user-state driver framework that provides two basic services: It provides device access interfaces to users state, and provide configuration IOMMU interfaces to users state. It just opens the IOMMU interface to user states for the first time, configuring IOMMU entirely in user mode, mapping the DMA address space and limiting it within the process virtual address space. VFIO can be utilized to implement efficient user state drivers. The virtualized scene can be used for PCI devices pass through. By configuring the IOMMU interface through the user state, the DMA address space mapping can be restricted to the process virtual space, This is especially important for a driver of high performance and device pass through in virtualization scenarios. VFIO supports UEFI better than traditional methods, VFIO technology enables user space to access devices directly. Users are not bound to have root permissions, more security, more functions.

3. System & environment
We need to do some environmental preparation to see if the hardware supports the pass through of graphics cards, Not all cards support pass through, FirePro cards, W2100, W3100, W9100 and so on are currently known in AMD graphics cards, And it needs Intel's vd-t technical support.

Hardware Information:
GPU: AMD Firepro W2100
CPU: Intel(R) Core(TM) i3-6100 CPU @ 3.70GHz
MEM: 32G
SSD: 480G
OS: CentOS 7.3 + Ocata

4. Implementation
① Update kernel for ‘CONFIG_VFIO_PCI_VGA’ and ‘i915 VGA arbiter patch’
   `[root@host016 gpu]# grep CONFIG_VFIO_PCI_VGA /boot/config -r
   /boot/config-3.10.0-514.16.1.el7.centos.plus.x86_64:CONFIG_VFIO_PCI_VGA=y`

② Modify grub parameter for intel_iommu and i915
   `[root@host016 gpu]# vi /etc/default/grub`
GRUB_CMDLINE_LINUX="crashkernel=auto rhgb quiet idel=poll idel=poll intel_iommu=on i915.enable_hd_vgaarb=1 modprobe.blacklist=nouveau"

[root@host016 gpu]# grub2-mkconfig -o /boot/grub2/grub.cfg

③ Modify default load system module and parameter
[root@host016 home]# echo "blacklist radeon" >> /etc/modprobe.d/blacklist.conf
[root@host016 home]# echo "options vfio_iommu_type1 allow_unsafe_interrupts=1" >> /etc/modprobe.d/vfio_iommu_type1.conf
[root@host016 home]# echo "options kvm ignore_msrs=1" >> /etc/modprobe.d/kvm.conf

④ Check pci info
[root@host016 home]# lspci | grep AMD
01:00.0 VGA compatible controller: Advanced Micro Devices, Inc. [AMD/ATI] Oland GL [FireProW2100]
01:00.1 Audio device: Advanced Micro Devices, Inc. [AMD/ATI] Cape Verde/Pitcairn HDMI Audio
[Radeon HD 7700/7800 Series]

⑤ Detach gpu from host
[root@host016 home]# lscpi -s 01:00.0 -v
01:00.0 VGA compatible controller: Advanced Micro Devices, Inc. [AMD/ATI] Oland GL [FirePro W2100] (prog-if 00 [VGA controller])
Subsystem: Advanced Micro Devices, Inc. [AMD/ATI] Device 2120
Flags: bus master, fast devsel, latency 0, IRQ 16
Memory at e0000000 (64-bit, prefetchable) [size=256M]
Memory at f7200000 (64-bit, non-prefetchable) [size=256K]
I/O ports at e000 [size=256]
Expansion ROM at f7240000 [disabled] [size=128K]
Capabilities: [48] Vendor Specific Information: Len=08 <?
Capabilities: [50] Power Management version 3
Capabilities: [58] Express Legacy Endpoint, MSI 00
Capabilities: [a0] MSI: Enable- Count=1/1 Maskable- 64bit+
Capabilities: [100] Vendor Specific Information: ID=0001 Rev=1 Len=010 <?
Capabilities: [150] Advanced Error Reporting
Capabilities: [200] #15
Capabilities: [270] #19
Kernel driver in use: vfio-pci
Kernel modules: radeon

If the information is: Kernel driver in use: vfio-pci. That explains the successful separation of video cards.

⑥ Check USB keyboard and mouse info
⑦ Create vm network(bridge)
⑧ Build start vm script
⑨ Boot vm and start
5. Results and discussion

Download the 3DMark software and GPU-Z software in the virtual machine, tested the performance of the AMD card, the results are as follows, we also used to play star games, The effect is very good and I can't feel the game is in the virtual machine.

As you can be clear from the above picture, the performance is very strong after passing through. The pass through of video cards has a certain complexity. There are different schemes for passing through. The hardware condition is very harsh. After a few tests, it's not very stable yet.

6. Conclusion

OpenStack and KVM have attracted much attention in the IT community, and KVM is an open source virtualization scheme, it has a strong development capacity, although the current market share is not high, maturity is not enough. But KVM has a very important place in the OpenStack computing virtualization layer. Therefore, in the KVM program, the video card pass through is still very long-term strategic significance.

Reference