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HOW TO: PASS GPU TO VM AND BACK WITHOUT X RESTART

PUBLISHED THU, MAR 31, 2016 BY ARSENIY SHESTAKOV

TLDR: If you use FOSS drivers with DRI3 you now can do this:

- Use GPU on Linux for any 3D applications.
- Pass it into VM and do anything with it.
- Once VM is shutdown use GPU on host again.

Everything without reboot and X server restart.

Long story:

I've been using a GPU passthrough with VFIO for two years now and I'm happy with it. Still, for me as a Linux nerd that likes to play around with FOSS drivers there was the huge downside that once the GPU was used in the VM it was impossible to use it on the host again without rebooting.

One year ago I made several attempts at making this work on Ubuntu 14.04 with the 3.19 kernel, but failed. Loading and unloading the Radeon kernel module a few times would leave me with a locked host. I tested many different ideas, but none worked and the best I could achieve was

getting the GPU to work after an X server restart, other VFIO users reported similar results.

Now I've finally switched to Kubuntu 16.04 and after a few days I managed to get it working with stock everything and the **ACS kernel patch**. It's hard to say what exactly made it work, but I suppose it is DRI3. My current setup looks like this:

- Host boot with UEFI. Used Legacy BIOS / CSM before.
- Host monitors connected to iGPU. One connected to dGPU as well for usage in VM.
- GPUs attached to radeon and intel kernel drivers. No blacklisting.
- Radeon and Intel DDX drivers is set use DRI3.

```
/etc/X11/xorg.conf.d/10-intel.conf:  
Section "Device"  
Identifier "Intel Graphics"  
Driver "intel"  
Option "DRI" "3"  
EndSection  
  
/etc/X11/xorg.conf.d/20-radeon.conf:  
Section "Device"  
Identifier "Radeon"  
Driver "radeon"  
Option "DRI3" "1"  
EndSection
```

- DRI_PRIME=1 to use dGPU on host:

```
DRI_PRIME=1 glxinfo | grep OpenGL
```

- To use in VM dGPU unbind from Radeon and bind to VFIO:

```
echo "1002 6719" > /sys/bus/pci/drivers/vfio-pci/new_id  
echo "0000:01:00.0" > /sys/bus/pci/devices/0000:01:00.0/driver/u  
echo "0000:01:00.0" > /sys/bus/pci/drivers/vfio-pci/bind  
echo "1002 6719" > /sys/bus/pci/drivers/vfio-pci/remove_id  
  
echo "1002 aa80" > /sys/bus/pci/drivers/vfio-pci/new_id  
echo "0000:01:00.1" > /sys/bus/pci/devices/0000:01:00.1/driver/u
```

```
echo "0000:01:00.1" > /sys/bus/pci/drivers/vfio-pci/bind  
echo "1002 aa80" > /sys/bus/pci/drivers/vfio-pci/remove_id
```

- After VM shutdown dGPU pass it back to Radeon. Most reliable way I found is device removal and PCI rescan:

```
echo 1 > /sys/bus/pci/devices/0000:01:00.0/remove  
echo 1 > /sys/bus/pci/devices/0000:01:00.1/remove  
echo 1 > /sys/bus/pci/rescan
```

So far I've restarted the VM several times, switching the GPU between host and VM and it looks solid. I haven't tested everything, but Unigine Valley on both Windows VM and Linux as well as a few games are stable. I hope others will be able to reproduce it with different hardware.

If you're interested in seeing what hardware I use as well as my QEMU configuration you can find it on [you can find it on gist](#). Since I just finished a major upgrade the VM is still using BIOS, but once everything settles down I'll switch to using EFI/OVMF. For general information about GPU passthroughs you can check [Alex Williamson blog](#) and the [vfio-users mailing list](#).

UPD1: Text patch by TGiFallen applied.

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SXX Arseniy Shestakov • 5 years ago • edited

BTW unfortunately this is impossible to setup on AMDGPU due to problems with unbind. Even if X server not running "unbind" won't do anything so it's impossible to use GPU in VM after host.

So if you can please confirm problem on bug trackers:

[FreeDesktop.org #97500](#)

[Kernel.org #150731](#)

UPD from 5.11.2016: Problem going to be fixed in kernel 4.10.

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g. • 5 years ago

Hello, I can get this to work, running TF2 via dri_prime 1 looks a bit glitchy, but passing the dGPU to the vm works fine. However my system freezes when I try to rescan, here's logs from systemctl <https://gist.github.com/ind...>

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SXX Arseniy Shestakov → **g.** • 5 years ago

Did you tried it with "Ignore" option for dGPU in X server config?

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g. → **SXX** • 5 years ago

If you mean the 30-radeon.conf from below then yup.

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SXX Arseniy Shestakov → **g.** • 5 years ago

Then there is very little I can do to help in comments my blog, but if you willing to contact me through freenode / skype then we can talk a bit more. Or whatever message system you might be using sent me contacts to:

me@thisblogdomain :-)

^ | v • Share >



Rokas Kupstys • 5 years ago

This is not a chance to even GPU without restarting X. For example:



SXX Arseniy Shestakov → Rokas Kupstys • 5 years ago

No it's not possible. X server should always have some "primary" GPU like Intel one. Also it doesn't handle hotplug properly if you use display connected to GPU so you can only use secondary GPUs for rendering offloading.

Also keep in mind that Nvidia not going to work that way even if this was possible. Their graphics stack isn't integrated at all and kernel module doesn't support hotplug at all.

In same time I feel it should be feasible to re-use Bumblebee on desktop hardware with hacky offloading via secondary X server. Nothing prevent it really, but someone have to go and try to setup it. Primary GPU would still be different.

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Manuel Zeusin • 4 years ago

Hello, it can be done with a nvidia (and nouveau) or amd (foss driver) instead of intel? my mobo and cpu doesn't have a integrated intel gpu

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Normand_Nadon • 4 years ago

Hello There,
introduction:

I've search the web for days and this page seems to be the closest to what I am trying to achieve...

I am running my PC with Ubuntu 14.04 as my main OS and dual booting to win7 for few things Linux can't handle for now (dx11 game per example)... The thing is that it takes forever to switch and that windows is taking a big chunk of unnecessary SSD space that could be easily managed with a VM...

The problem is that in the foreseeable future, I am not going to add a secondary Graphics card for GPU pass-through (\$\$\$) but my games won't even come close to run on a VM with a virtualised GPU...

My goal is to boot my Linux machine, and when I need windows for a task, load the VM and disconnect GPU from host to pass it through the VM... Is that what you achieved here?... I am kind of new to this matter!

/introduction

My hardware is:

990-FXA-UD7 mobo with UEFI and virtualisation enabled

AMD 1100t 6 cores CPU

16gb of DDR3 RAM

Nvidia GeForce GTS450 GPU (I know... I know!... does the job, not more!)

with unbind as far as I can see.

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Thomas Wegele • 5 years ago

Hello,

thanks to you and some further reading i finally managed to fix my rescan-issue
seems like me pci-e port isnt isolated so i need to use linux-vfio-kernel.

now i only need to look what patches/config i need for my custom kernel and i'm all
set.

thanks a lot for your help in the past ;)

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SXX Arseniy Shestakov → Thomas Wegele • 5 years ago • edited

That's a good news. Please post if you manage to make it work. :-)

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Thomas Wegele → SXX • 5 years ago

hey man, i'm sorry but i seem to have been to fast on my report.

thing is i really got rebind working, but i have now figured out that the
issue was something else:

after installing vfio-kernel i also switched the wm from xfce4 to
gnome.

after some further testing i can now tell you that it's something about
xfce4 that breaks rebind on my setup.

for testing i made a clean install of antergos xfce and set up my
configs and scripts for passthrough.

on xfce4 i get a system-freeze when i try to rebind, but as soon as i
switch the wm to something else (e.g. i3) i can use rebind without any
issues.

i'd like to investigate further but to be honest i have no idea where to
start :P

new target is to get rebind working with xfce since i don't want to
change my wm for this functionality

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pci rescan

any idea?

^ | v • Share ›



SXX Arseniy Shestakov → Thomas Wegele • 5 years ago • edited

I probably should really enable email notification on comments (yep i enabled it! so next time I'll answer much faster).

Sadly I not sure why you might have freeze, but I might suspect this can have something to do with AMD GPU reset issue on VM shutdown. It's happen because GPU remain in some wrong state and when system try to reattach it to the driver that might cause host lockup. Same would happen if you try to stop and start VM again.

Known workaround for this is remove device using Device Manager in Windows before you shutdown VM. If this doesn't work you can post here or on [/r/VFIO](#) since I check every topic here and there is more guys who can help you.

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Thomas Wegele → SXX • 5 years ago

Thanks for the reply. Thing is i can stop and restart vm without any problem.

Furthermore the rescan also freezes my system if i rescan directly after binding to vfio without even starting my vm.

Later i might try to powercycle pci-device and/or take a look at the forums.

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SXX Arseniy Shestakov → Thomas Wegele • 5 years ago

Did you tried to reattach to Radeon without remove / rescan?

You need to get it working first with both GPU attached properly.

I only tried today and 3d rendering (e.g. steam games) is done by igpu even though output of `DRI_PRIME=1 glxinfo | grep OpenGL` seems correct now.

If for instance it's work for "glxgears" then it's will work on Steam games. In case it's not work that only mean you passed options wrong.

In case of Steam you must set it via "**Set Launch Options**":

```
DRI_PRIME=1 %command%
```

Let me guess, to rebind without rescan i should use

Correct. If you use modern kernel and libvirt (like in Ubuntu 16.04) then you can as well do not use any kernel options to bind GPU on startup (so no `pci-stub.ids`, `vfio-pci.ids`).

Instead simply use "virsh" to bind card to **vfio-pci**:

```
virsh nodedev-detach pci_0000_02_00_0
```

Then you can reattach it back to **radeon** using:

```
virsh nodedev-reattach pci_0000_02_00_0
```


i guess its an issue with intel drivers:

```
DRI_PRIME=1 glxinfo | grep OpenGL
```

```
libGL error: Different GPU, but blitImage not implemented for this driver
```

```
libGL error: failed to load driver: i965
```



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