

# IOMMU

```
nano /etc/default/grub
```

**"GRUB\_CMDLINE\_LINUX\_DEFAULT"**

```
GRUB_CMDLINE_LINUX_DEFAULT="quiet intel_iommu=on"
```

**grub**

```
update-grub
```

Reboot

```
dmesg | grep -e DMAR -e IOMMU
```

**DMAR IOMMU enabled**

Intel	AMD	"iommu=pt"	cmdline
-------	-----	------------	---------

```
iommu = pt
```

IOMMU	PCIe	VM	DMA
-------	------	----	-----

```
/etc/modules
```

```
vfio
vfio_iommu_type1
vfio_pci
vfio_virqfd
```

5.4

## IOMMU

PCI “ “[ ]” ” “ ”

Intel Intel Virtualization Technology for Directed I/O (VT-d)

```
dmesg | grep 'remapping'
```

- "AMD-Vi: Interrupt remapping enabled"
- "DMAR-IR: Enabled IRQ remapping in x2apic mode" ('x2apic' can be different on old CPUs, but should still work)

```
echo "options vfio_iommu_type1 allow_unsafe_interrupts=1" >  
/etc/modprobe.d/iommu_unsafe_interrupts.conf
```

## IOMMU

PCI IOMMU VM PCI

```
# find /sys/kernel/iommu_groups/ -type l  
/sys/kernel/iommu_groups/0/devices/0000:00:00.0  
/sys/kernel/iommu_groups/1/devices/0000:00:01.0  
/sys/kernel/iommu_groups /1/devices/0000:01:00.0  
/sys/kernel/iommu_groups/1/devices/0000:01:00.1  
/sys/kernel/iommu_groups/2/devices/0000:00:02.0  
/sys/kernel/iommu_groups/3 /devices/0000:00:16.0  
/sys/kernel/iommu_groups/4/devices/0000:00:1a.0  
/sys/kernel/iommu_groups/5/devices/0000:00:1b.0  
/sys/kernel/iommu_groups /6/devices/0000:00:1c.0  
/sys/kernel/iommu_groups/7/devices/0000:00:1c.5  
/sys/kernel/iommu_groups/8/devices/0000:00:1c.6  
/sys /kernel/iommu_groups/9/devices/0000:00:1c.7  
/sys/kernel/iommu_groups/9/devices/0000:05:00.0  
/sys/kernel/iommu_groups/10/devices/0000:00:1d.0  
/sys/kernel/iommu_groups/11/devices/0000:00:1f.0  
/sys/kernel/iommu_groups/11/devices/0000:00:1f.2  
/sys/kernel/iommu_groups/11/devices/0000:00:1f.3  
/sys/kernel/iommu_groups/12/devices/0000:02:00.0  
/sys/kernel/iommu_groups/12/devices/0000:02:00.1
```

```
/sys/kernel/iommu_groups/13/devices/0000:03:00.0
```

```
/sys/kernel/iommu_groups/14/devices/0000:04:00.0
```

IOMMU

ACS

BIOS

E3-1200

E3 E5

Intel Core

<https://ark.intel.com>

ACS

Haswell-E (LGA2011-v3)

i7-5960X (8-core, 3/3.5GHz)

i7-5930K (6-core, 3.2/3.8GHz)

i7-5820K (6-core, 3.3/3.6GHz)

Ivy Bridge-E (LGA2011)

i7-4960X (6-core, 3.6/4GHz)

i7-4930K (6-core, 3.4/3.6GHz)

i7-4820K (4-core, 3.7/3.9GHz)

Sandy Bridge-E (LGA2011)

i7-3960X 6 3.3/3.9GHz

i7-3970X 6 3.5/4GHz

i7-3930K 6 3.2/3.8GHz

i7-3820 4 3.6/3.8GHz

Ryzen

AMD

IOMMU

1) pci

2) "pcie\_acs\_override=downstream"

grub systemd-boot

ACS

<http://vfio.blogspot.be/2015/10/intel-processors-with-acs-support.html>

<http://vfio.blogspot.be/2014/08/iommu-groups-inside-and-out.html>

## PCI

GUI VM

"Host PCI"

"lspci"                      01:00.0      <vmid>.conf                      /etc/pve/qemu-server/vmid.conf

```
hostpci0: 01:00.0
```

vga

```
hostpci0: 01:00.0; 01:00.1
```

```
hostpci0: 01:00
```

## PCI Express

GUI    "PCI-E"                      pcie=1                      VM

```
machine: q35
hostpci0: 01:00.0, pcie=1
```

PCIe                      Q35

PCI                      PCIe                      "                      PCI                      "

## GPU

VM                      4

## GPU OVMF PCI

VM    "OVMF"    "BIOS"                      "SeaBIOS"                      uefi                      Windows                      win >=8

OVMF                      disable\_vga=1                      vfio-pci                      vga

```
echo "options vfio-pci ids=10de:1381,10de:0fbc disable_vga=1" > /etc/modprobe.d/vfio.conf
```

UEFI <http://www.vfio-blog.com/2014/08/does-my-graphics-card-rom-support-efi.html>

```
bios: ovmf
scsihw: virtio-scsi-pci
bootdisk: scsi0
scsi0: .....
hostpci0: 01:00, x-vga=on
```

# GPU OVMF PCI Express

q35      pcie=1

```
bios: ovmf
scsihw: virtio-scsi-pci
bootdisk: scsi0
scsi0: .....
machine: q35
hostpci0: 01:00, pcie=1, x-vga=on
```

## GPU Seabios PCI

```
hostpci0: 01:00, x-vga=on
```

## GPU Seabios PCI Express

```
machine: q35
hostpci0: 01:00, pcie=1, x-vga=on
```

## UEFI (OVMF)

“rom-parser”

```
git clone https://github.com/awilliam/rom-parser
cd rom-parser
make
```

VGA    ROM

```
cd /sys/bus/pci/devices/0000:01:00.0/
echo 1 > rom
cat rom > /tmp/image.rom
echo 0 > rom
```

```
./rom-parser /tmp/image.rom
```

```
Valid ROM signature found @0h, PCIR offset 190h
PCIR: type 0, vendor: 10de, device: 1280, class: 030000
```

```
PCIR: revision 0, vendor revision: 1
Valid ROM signature found @f400h, PCIR offset 1ch
PCIR: type 3, vendor: 10de, device: 1280, class: 030000
PCIR: revision 3, vendor revision: 0
EFI: Signature Valid
Last image
```

UEFI “ 3”

## NVIDIA

Windows geforce experience Passmark Performance Test SiSoftware Sandra crash V

```
echo " kvm ignore_msrs=1" > /etc/modprobe.d/kvm.conf
```

“dmesg”

```
echo "options kvm ignore_msrs=1 report_ignored_msrs=0" > /etc/modprobe.d/kvm.conf
```

NVIDIA Kepler K80 GPU vmid.conf

```
args: -machine pc,max-ram-below-4g=1G
```

## “romfile”

<http://lime-technology.com/forum/index.php?topic=43644.msg482110#msg482110>

PCI(e) GPU vbios “ ” vBIOS

BIOS

```
cd /sys/bus/pci/devices/0000:01:00.0/
echo 1 > rom
cat rom > /usr/share/kvm/vbios.bin
echo 0 > rom
```

vbios /usr/share/kvm/

```
hostpci0: 01:00, x-vga=on,romfile=vbios.bin
```

# BAR 3 [mem]

VM

```
vfio-pci 0000:04:00.0: BAR 3: can't reserve [mem 0xca000000-0xcbffffff 64bit]
```

```
video=efifb:off
```

Spice GPU “ ”PCI SPICE

## HDMI /

GPU MSI MSI

<https://github.com/CHEF-KOCH/MSI-utility/releases/latest>

Linux MSI MSI GPU

```
echo "options snd-hda-intel enable_msi=1" >> /etc/modprobe.d/snd-hda-intel.conf
```

“lspci -vv” MSI

```
Capabilities: [a0] MSI: Enable+ Count=1/1 Maskable- 64bit+
```

“ +” MSI “ -” PCIe MSI

GPU

## BIOS

BIOS IOMMU

BIOS

- IOMMU VT-d “ ” “ ”
- 'Legacy boot' CSM GPU PVE UEFI BIOS
- “Resizable BAR”/“Smart Access Memory” AMD GPU Vega Windows

CLI qm “qm monitor vmnumber” “info pci”

PCI

VM

VM

proxmox

PCI

ZFS FreeNAS Openfiler OpenIO

<https://forums.freenas.org/threads/absolutely-must-virtualize-freenas-a-guide-to-not-completely-losing-your-data.12714/>

## USB

USB

wiki

[https://pve.proxmox.com/wiki/USB\\_physical\\_port\\_mapping](https://pve.proxmox.com/wiki/USB_physical_port_mapping)

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