kernel hacker 修炼之道——李万鹏

男儿立志出乡关， 学不成名死不还。 埋骨何须桑梓地， 人生无处不青山。 ——西乡隆盛诗

kernel hacker修炼之道之PCI subsystem(二)

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kernel hacker修炼之道之PCI subsystem(二)

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这里主要介绍pci subsystem的调试方式lspci tool，这个工具的使用方法可以通过man查看。

1.直接用lspci可以查看系统中都有哪些PCI device(bridge也是PCI device)

```
hacker@hacker:~$ lspci
00:00.0 Host bridge: Intel Corporation Mobile 945GM/PM/GMS,
943/940GML and 945GT Express Memory Controller Hub (rev 03)
00:01.0 PCI bridge: Intel Corporation Mobile 945GM/PM/GMS,
943/940GML and 945GT Express PCI Express Root Port (rev 03)
00:1b.0 Audio device: Intel Corporation N10/ICH 7 Family High
Definition Audio Controller (rev 02)
00:1c.0 PCI bridge: Intel Corporation N10/ICH 7 Family PCI Express
Port 1 (rev 02)
00:1c.1 PCI bridge: Intel Corporation N10/ICH 7 Family PCI Express
Port 2 (rev 02)
00:1c.2 PCI bridge: Intel Corporation N10/ICH 7 Family PCI Express
Port 3 (rev 02)
00:1c.3 PCI bridge: Intel Corporation N10/ICH 7 Family PCI Express
Port 4 (rev 02)
00:1d.0 USB Controller: Intel Corporation N10/ICH 7 Family USB UHCI
Controller #1 (rev 02)
00:1d.1 USB Controller: Intel Corporation N10/ICH 7 Family USB UHCI
Controller #2 (rev 02)
00:1d.2 USB Controller: Intel Corporation N10/ICH 7 Family USB UHCI
Controller #3 (rev 02)
00:1d.3 USB Controller: Intel Corporation N10/ICH 7 Family USB UHCI
```

```
Controller #4 (rev 02)
00:1d.7 USB Controller: Intel Corporation N10/ICH 7 Family USB2
EHCI Controller (rev 02)
00:1e.0 PCI bridge: Intel Corporation 82801 Mobile PCI Bridge (rev
e2)
00:1f.0 ISA bridge: Intel Corporation 82801GBM (ICH7-M) LPC
Interface Bridge (rev 02)
00:1f.1 IDE interface: Intel Corporation 82801G (ICH7 Family) IDE
Controller (rev 02)
00:1f.2 SATA controller: Intel Corporation 82801GBM/GHM (ICH7
Family) SATA AHCI Controller (rev 02)
00:1f.3 SMBus: Intel Corporation N10/ICH 7 Family SMBus Controller
(rev 02)
01:00.0 VGA compatible controller: ATI Technologies Inc M56GL
[Mobility FireGL V5200]
02:00.0 Ethernet controller: Intel Corporation 82573L Gigabit
Ethernet Controller
03:00.0 Ethernet controller: Atheros Communications Inc. AR5212
802.11abg NIC (rev 01)
15:00.0 CardBus bridge: Texas Instruments PCI1510 PC card Cardbus
Controller
```

2.使用lspci -t可以得到PCI domain，bus，device，function的树状视图：

```
hacker@hacker:~$ lspci -t
-[0000:00]-+-00.0
           +-01.0-[01]----00.0
           +-1b.0
           +-1c.0-[02]----00.0
           +-1c.1-[03]----00.0
           +-1c.2-[04-0b]--
           +-1c.3-[0c-13]--
           +-1d.0
           +-1d.1
           +-1d.2
           +-1d.3
           +-1d.7
           +-1e.0-[15-18]----00.0
           +-1f.0
           +-1f.1
           +-1f.2
           \-1f.3
```

这里的格式转化成二进制是这样的：

domain(16bit):bus(8bit):device(5bit):function(3bit)

比如这里的0000:00:1d.1就是domain 0000中的bus 00上的device(实际上是个slot) 1d的function(实际上是个logical device) 0

3.使用lspci -x可以dump出PCI device configuration space的64bytes头信息：

```
hacker@hacker:~$ lspci -x
00:00.0 Host bridge: Intel Corporation Mobile 945GM/PM/GMS,
943/940GML and 945GT Express Memory Controller Hub (rev 03)
00: 86 80 a0 27 06 01 90 20 03 00 00 06 00 00 00 00
10: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
20: 00 00 00 00 00 00 00 00 00 00 00 00 aa 17 15 20
30: 00 00 00 00 e0 00 00 00 00 00 00 00 00 00 00 00


00:01.0 PCI bridge: Intel Corporation Mobile 945GM/PM/GMS,
943/940GML and 945GT Express PCI Express Root Port (rev 03)
00: 86 80 a1 27 07 05 10 00 03 00 04 06 10 00 01 00
10: 00 00 00 00 00 00 00 00 00 01 01 00 20 20 00 20
20: 10 ee 10 ee 01 d0 f1 df 00 00 00 00 00 00 00 00
30: 00 00 00 00 88 00 00 00 00 00 00 00 0b 01 1c 00


00:1b.0 Audio device: Intel Corporation N10/ICH 7 Family High
Definition Audio Controller (rev 02)
00: 86 80 d8 27 06 05 10 00 02 00 03 04 10 00 00 00
10: 04 00 40 ee 00 00 00 00 00 00 00 00 00 00 00 00
20: 00 00 00 00 00 00 00 00 00 00 00 00 aa 17 10 20
30: 00 00 00 00 50 00 00 00 00 00 00 00 0b 02 00 00


00:1c.0 PCI bridge: Intel Corporation N10/ICH 7 Family PCI Express
Port 1 (rev 02)
00: 86 80 d0 27 07 05 10 00 02 00 04 06 10 00 81 00
10: 00 00 00 00 00 00 00 00 00 02 02 00 30 30 00 00
20: 00 ee 00 ee 01 80 11 80 00 00 00 00 00 00 00 00
30: 00 00 00 00 40 00 00 00 00 00 00 00 0b 01 04 00

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```
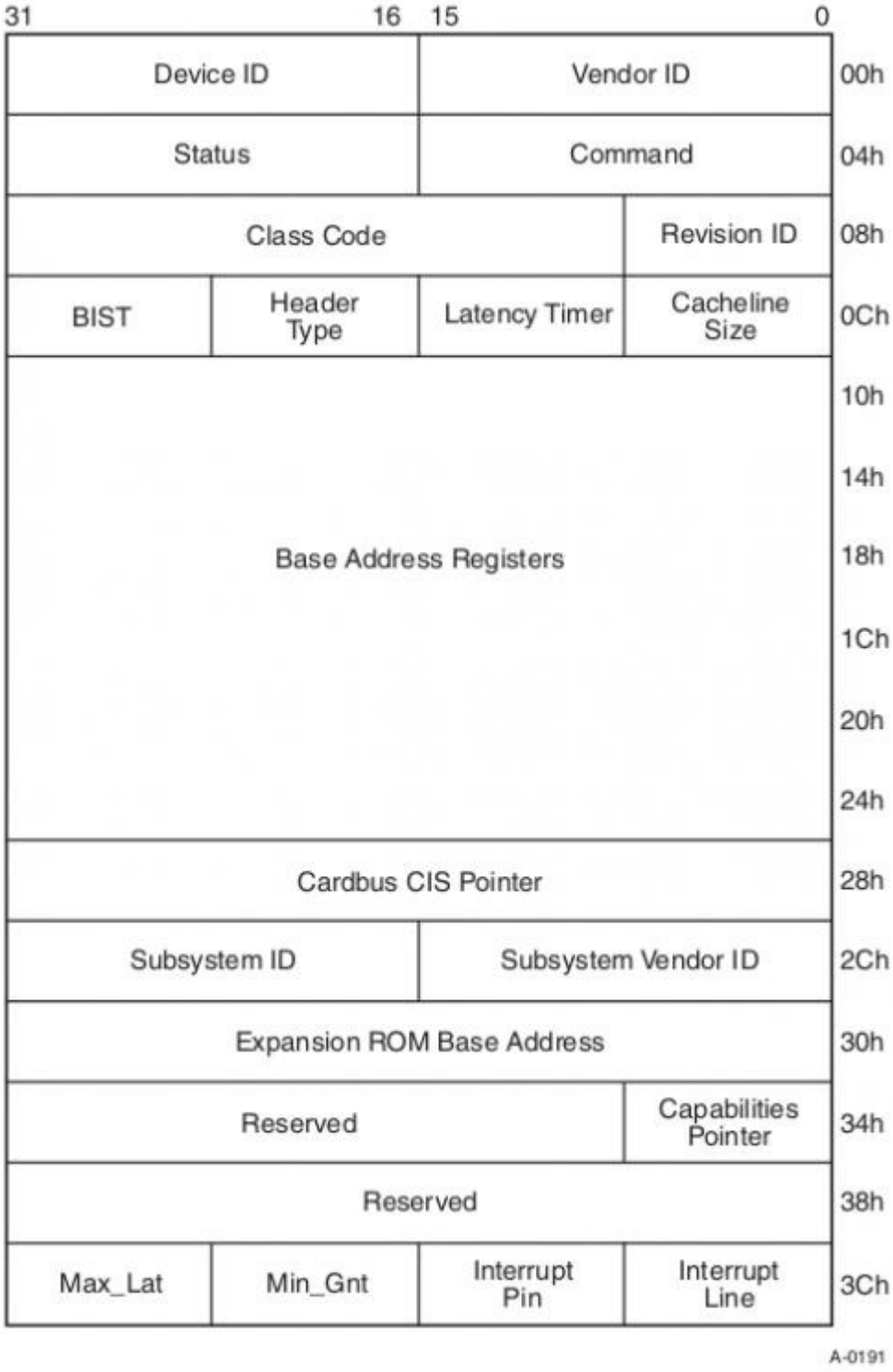

这64bytes头信息可以与下边的图对比查看，eg. 从途中看到Vendor ID(厂商号)对应低16bits，dump出的信息前16bits为86 80，因为这些寄存器都是小端的，所以是0x8086，这个我们就很熟悉了吧，哈哈！其他信息可以依次对比查看。



4.使用lspci -v可以查看各个PCI device的基本信息：

```
hacker@hacker:~$ lspci -v
00:00.0 Host bridge: Intel Corporation Mobile 945GM/PM/GMS,
943/940GML and 945GT Express Memory Controller Hub (rev 03)
        Subsystem: Lenovo ThinkPad T60
        Flags: bus master, fast devsel, latency 0
        Capabilities: <access denied>


00:01.0 PCI bridge: Intel Corporation Mobile 945GM/PM/GMS,
943/940GML and 945GT Express PCI Express Root Port (rev 03) (prog-
if 00 [Normal decode])
        Flags: bus master, fast devsel, latency 0
        Bus: primary=00, secondary=01, subordinate=01, sec-
latency=0
        I/O behind bridge: 00002000-00002fff
        Memory behind bridge: ee100000-ee1fffff
        Prefetchable memory behind bridge:
00000000d0000000-00000000dfffffff
        Capabilities: <access denied>
        Kernel driver in use: pcieport
        Kernel modules: shpchp


00:1b.0 Audio device: Intel Corporation N10/ICH 7 Family High
Definition Audio Controller (rev 02)
        Subsystem: Lenovo ThinkPad T60/R60 series
        Flags: bus master, fast devsel, latency 0, IRQ 48
        Memory at ee400000 (64-bit, non-prefetchable) [size=16K]
        Capabilities: <access denied>
        Kernel driver in use: HDA Intel
        Kernel modules: snd-hda-intel
```

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5.使用lspci -tv既可以查看树又可以查看一些信息

```
hacker@hacker:~$ lspci -tv

-[0000:00]-+-00.0  Intel Corporation Mobile 945GM/PM/GMS,
```

```
943/940GML and 945GT Express Memory Controller Hub
           +-01.0-[01]----00.0  ATI Technologies Inc M56GL
[Mobility FireGL V5200]
           +-1b.0  Intel Corporation N10/ICH 7 Family High
Definition Audio Controller
           +-1c.0-[02]----00.0  Intel Corporation 82573L Gigabit
Ethernet Controller
           +-1c.1-[03]----00.0  Atheros Communications Inc. AR5212
802.11abg NIC
           +-1c.2-[04-0b]--
           +-1c.3-[0c-13]--
           +-1d.0  Intel Corporation N10/ICH 7 Family USB UHCI
Controller #1
           +-1d.1  Intel Corporation N10/ICH 7 Family USB UHCI
Controller #2
           +-1d.2  Intel Corporation N10/ICH 7 Family USB UHCI
Controller #3
           +-1d.3  Intel Corporation N10/ICH 7 Family USB UHCI
Controller #4
           +-1d.7  Intel Corporation N10/ICH 7 Family USB2 EHCI
Controller
           +-1e.0-[15-18]----00.0  Texas Instruments PCI1510 PC
card Cardbus Controller
           +-1f.0  Intel Corporation 82801GBM (ICH7-M) LPC
Interface Bridge
           +-1f.1  Intel Corporation 82801G (ICH7 Family) IDE
Controller
           +-1f.2  Intel Corporation 82801GBM/GHM (ICH7 Family)
SATA AHCI Controller
           \-1f.3  Intel Corporation N10/ICH 7 Family SMBus
Controller
```