Virtualizing Mac OS X

Leopard in a cage

About me

- Alexander Graf
- Working for SUSE Linux Products GmbH
  - Research on KVM / Qemu
  - SUSE Studio

Goal

- Make Mac OS X boot in KVM

Why

- Improve emulation accuracy
- Proof that it can be done
- Enable users to use Linux, whilst keeping Mac applications

The Challenge

- OS X bundled with Hardware
- Only supports Apple Hardware
- Is dongled with Apple Hardware
- Boots differently

What is an Intel Mac

	Mac
CPU	Core(2)Duo
ISA Bridge	ICH-7 LPC
HPET	yes
IDE	ICH-7
Additional	AppleSMC
Firmware	EFI
ACPI	Full-Blown

What does Qemu provide

	Qemu
CPU	Non-existing AMD64
ISA Bridge	PIIX3
HPET	no
IDE	PIIX3
Additional	-
Firmware	BIOS
ACPI	Rudimentary

Qemu vs. Mac

	Mac	Qemu
CPU	Core(2)Duo	Non-existing AMD64
ISA Bridge	ICH-7 LPC	PIIX3
HPET	yes	no
IDE	ICH-7	PIIX3
Additional	AppleSMC	-
Firmware	EFI	BIOS
ACPI	Full-Blown	Rudimentary

How

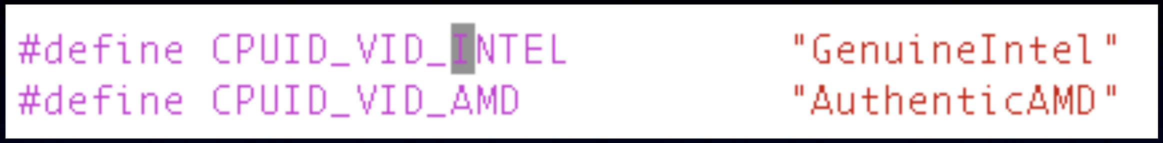
- Emulate devices that Mac OS X supports
- Provide a way to boot Mac OS X
- Pass through the dongle key

CPU

- Checks for GenuineIntel and certain CPU Families
- Requires
  - SSE2 for 32-bit
  - SSE3 for PPC emulation
  - SSSE3 for 64-bit

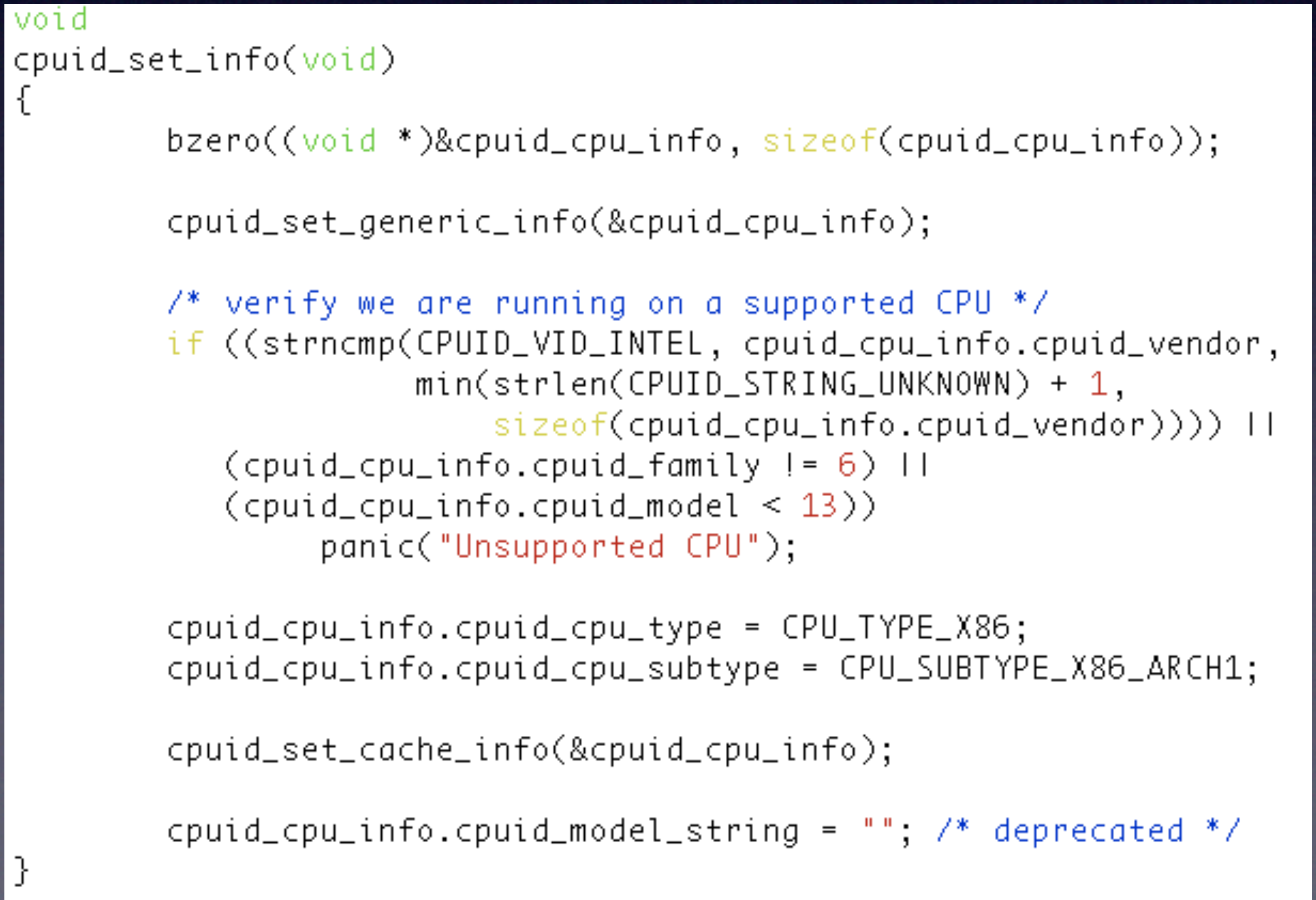
CPU

cpuid.h



```
#define CPUID_VID_INTEL                 "GenuineIntel"
#define CPUID_VID_AMD                   "AuthenticAMD"
```

cpuid.c



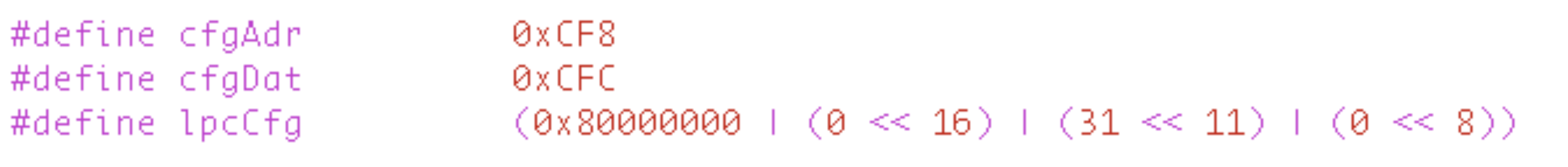
```
void
cpuid_set_info(void)
{
        bzero((void *)&cpuid_cpu_info, sizeof(cpuid_cpu_info));

        cpuid_set_generic_info(&cpuid_cpu_info);

        /* verify we are running on a supported CPU */
        if ((strncmp(CPUID_VID_INTEL, cpuid_cpu_info.cpuid_vendor,
                     min(strlen(CPUID_STRING_UNKNOWN) + 1,
                         sizeof(cpuid_cpu_info.cpuid_vendor)))) ||
           (cpuid_cpu_info.cpuid_family != 6) ||
           (cpuid_cpu_info.cpuid_model < 13))
                panic("Unsupported CPU");

        cpuid_cpu_info.cpuid_cpu_type = CPU_TYPE_X86;
        cpuid_cpu_info.cpuid_cpu_subtype = CPU_SUBTYPE_X86_ARCH1;

        cpuid_set_cache_info(&cpuid_cpu_info);

        cpuid_cpu_info.cpuid_model_string = ""; /* deprecated */
}
```

ICH7

- Accesses PCI config space registers for LPC unconditionally
- Does not detect older IDE-controllers
- Accesses HPET unconditionally

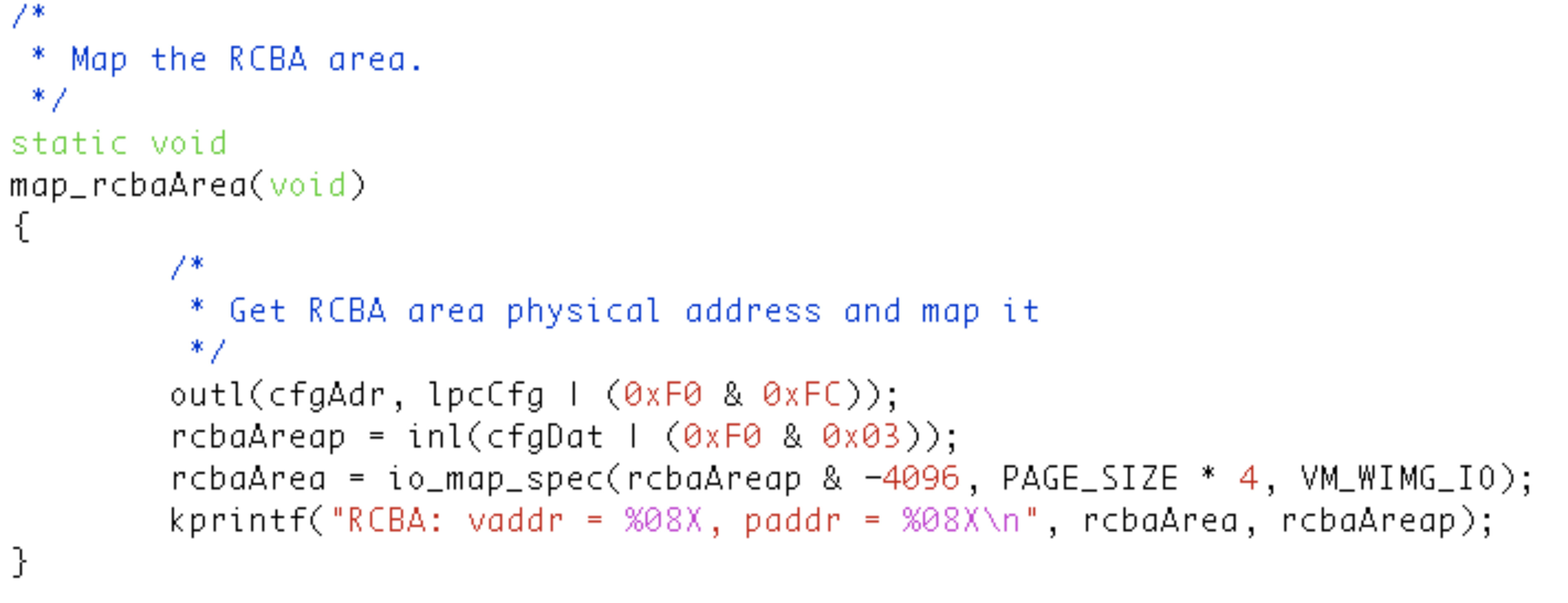
ICH7

pmCPU.h

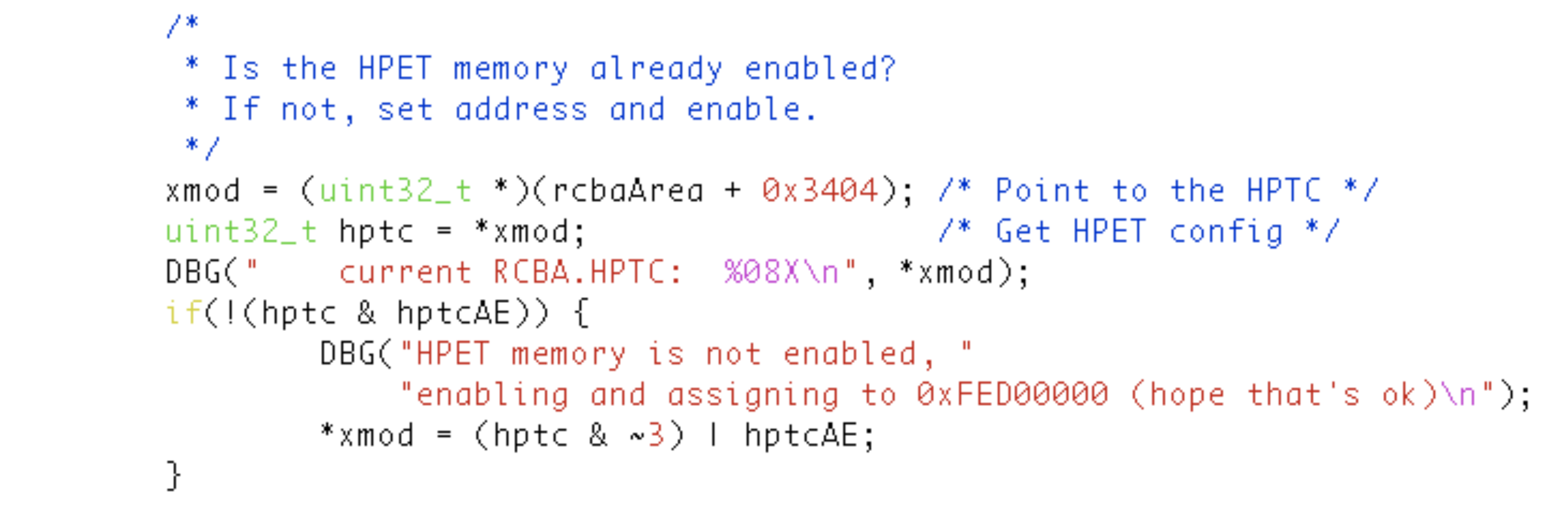


```
#define cfgAdr          0xCF8
#define cfgDat          0xCFC
#define lpcCfg          (0x80000000 | (0 << 16) | (31 << 11) | (0 << 8))
```

hpet.c



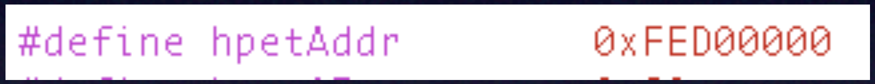
```
/*
 * Map the RCBA area.
 */
static void
map_rcbaArea(void)
{
        /*
         * Get RCBA area physical address and map it
         */
        outl(cfgAdr, lpcCfg | (0xF0 & 0xFC));
        rcbaAreap = inl(cfgDat | (0xF0 & 0x03));
        rcbaArea = io_map_spec(rcbaAreap & -4096, PAGE_SIZE * 4, VM_WIMG_IO);
        kprintf("RCBA: vaddr = %08X, paddr = %08X\n", rcbaArea, rcbaAreap);
}
```



```
        /*
         * Is the HPET memory already enabled?
         * If not, set address and enable.
         */
        xmod = (uint32_t *)(rcbaArea + 0x3404); /* Point to the HPTC */
        uint32_t hptc = *xmod;                  /* Get HPET config */
        DBG("    current RCBA.HPTC:  %08X\n", *xmod);
        if(!(hptc & hptcAE)) {
                DBG("HPET memory is not enabled, "
                    "enabling and assigning to 0xFED00000 (hope that's ok)\n");
                *xmod = (hptc & ~3) | hptcAE;
        }
```

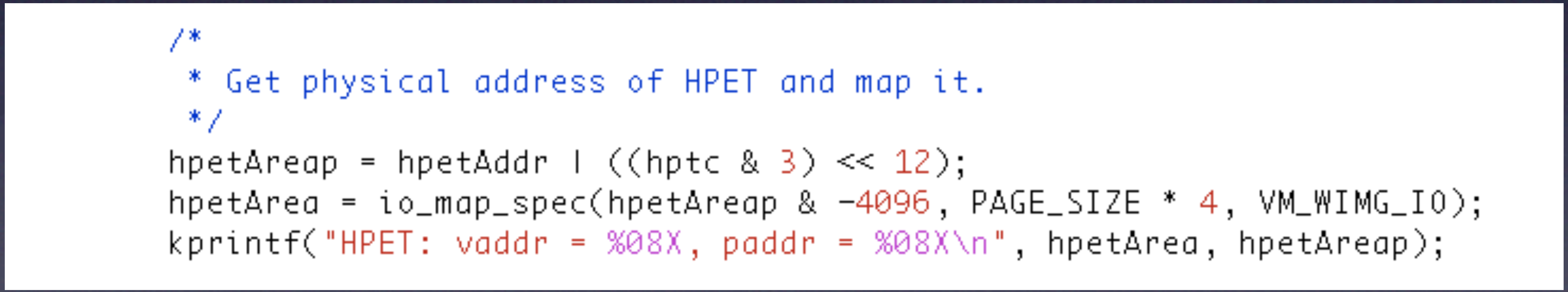
ICH7

hpet.h



```
#define hpetAddr          0xFED00000
```

hpet.c



```
        /*
         * Get physical address of HPET and map it.
         */
        hpetAreap = hpetAddr | ((hptc & 3) << 12);
        hpetArea = io_map_spec(hpetAreap & -4096, PAGE_SIZE * 4, VM_WIMG_IO);
        kprintf("HPET: vaddr = %08X, paddr = %08X\n", hpetArea, hpetAreap);
```

EFI

- EFI Implemention for Qemu exists
  - Not up-to-date
  - No support for HFS+
- BIOS bootloader for Mac OS X exists
  - Convenient
  - Patched version by David Elliot to run new kernels

AppleSMC

- System Management Chip for
  - Fan Control
  - Backlight Control
  - Dongle key storage
- Easy to emulate
- Key must be given by user

What works

- Mac OS X
- Rosetta
- 64-Bit
- Network
- USB

What does not work

- Graphic glitches
- Sound
- In-kernel APIC
- About This Mac
- Keynote

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Where to get it

- http://alex.csgraf.de/qemu/osxpatches.tar.bz2

DEMO

Questions?