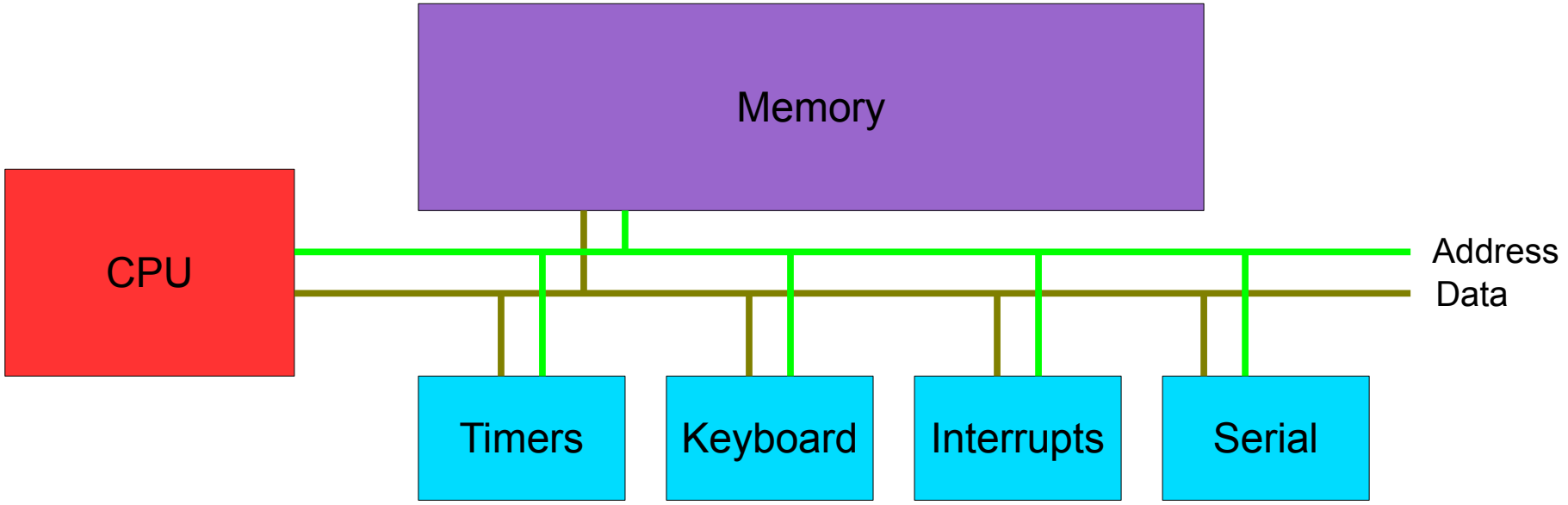
I/O Ports

ECE 373

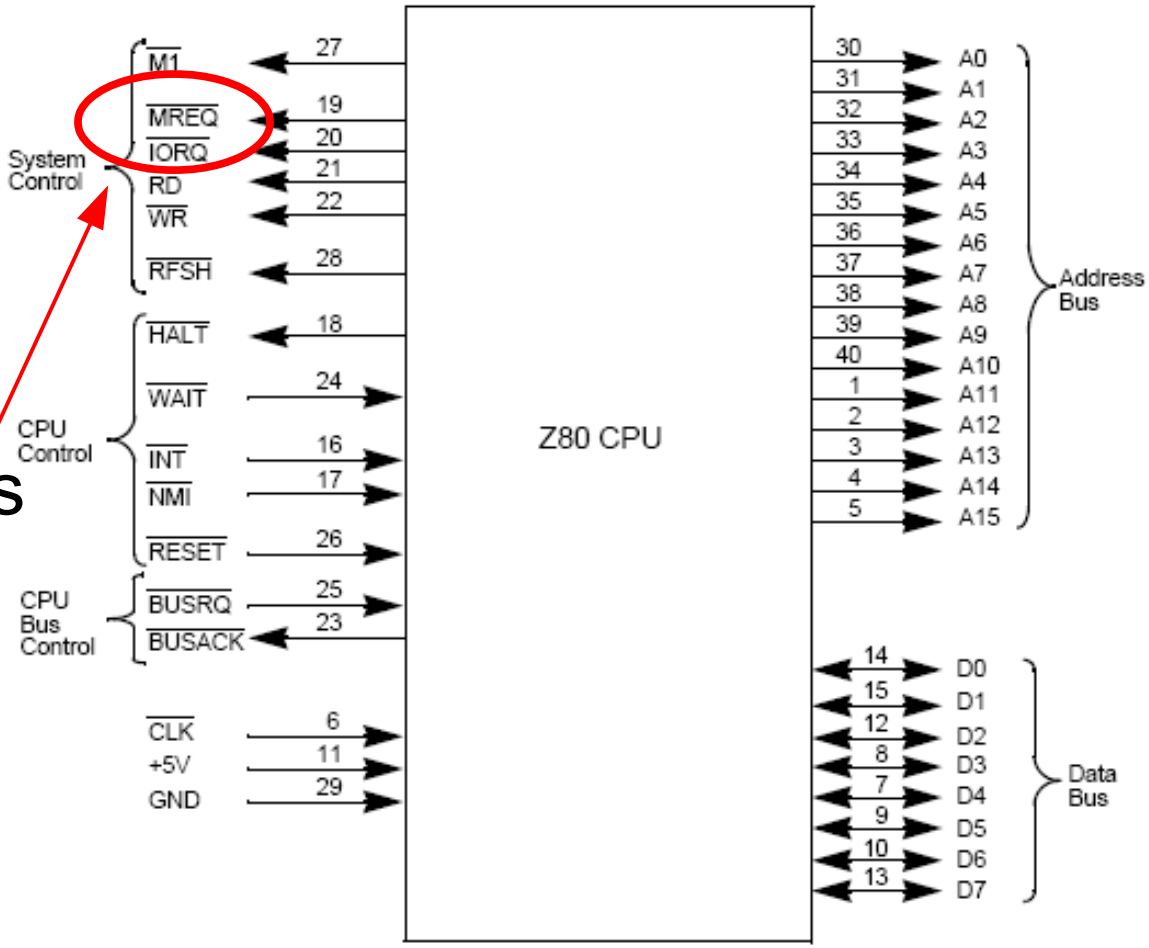
Talking to Hardware

- Fast memory
- Slow everything else
  - Clock, printer, UART, keyboard, mouse, interrupt controller, soundboard, disk controllers, joystick, ..



Port Mapped I/O

- Separate mode allows for special circuitry
  - Data buffering for slow devices
  - Transitions to alternate logic level devices
- Shares data and address lines
- Special CPU ops to enable IO request
  - inb <reg>
  - outb <val> <reg>



Port Mapped I/O

- 0-65535 ports shared among devices
- Often in pairs and/or sets
  - Write to 0x20 to select interrupt control register
  - Read/write 0x21 for data transfer
- System designers have to cooperate on port assignments

```
$ cat /proc/ioports
0000-001f : dma1
0020-0021 : pic1
0040-0043 : timer0
0050-0053 : timer1
0060-0060 : keyboard
0064-0064 : keyboard
0070-0071 : rtc0
0080-008f : dma page reg
00a0-00a1 : pic2
00c0-00df : dma2
00f0-00ff : fpu
0290-029f : pnp 00:07
  0290-029f : pnp 00:07
03c0-03df : vga+
03f8-03ff : serial
   ...
   ...
   ...
```

Simple Code

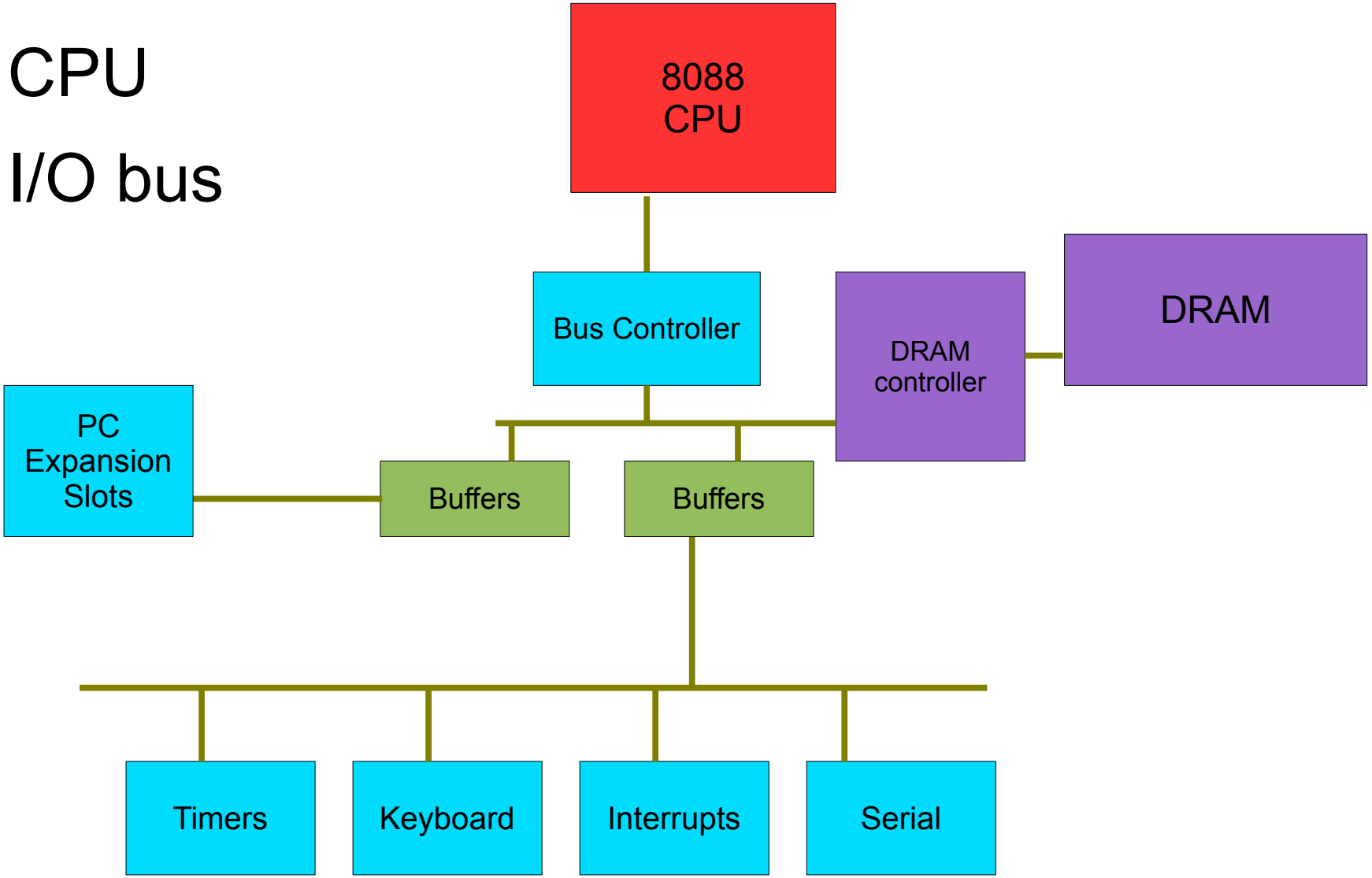
```
#include <asm/io.h>

static uint8_t gpio_led_on(void)
{
        u8 reg;

        /* knock knock */
        outb(0x87, 0x2e);
        outb(0x87, 0x2e);

        /* enable GPIO pin 1 */
        outb(0xf1, 0x2e);
        reg = inb(0x2f);
        reg |= 0x2;
        outb(reg, 0x2f);

        /* lock up */
        outb(0xaa, 0x2e);

        return reg;
}
```

Linux Driver

```
#include <linux/ioport.h>
#include <asm/io.h>

struct resource *io_region;

static int __init ece_gpio_init(void)
{
        ... other stuff ...

        io_region = request_region(0x2e, 2, "ece_gpio");
        if (io_region == NULL) {
                printk(KERN_ERR "couldn't get IO region, aborting\n");
                goto io_fail;
        }
        gpio_led_on();
        return 0;

io_fail:
        ... clean up other stuff ...
        return 1;
}

static void __exit ece_fan_exit(void)
{
        release_region(0x2e, 2);
}
```

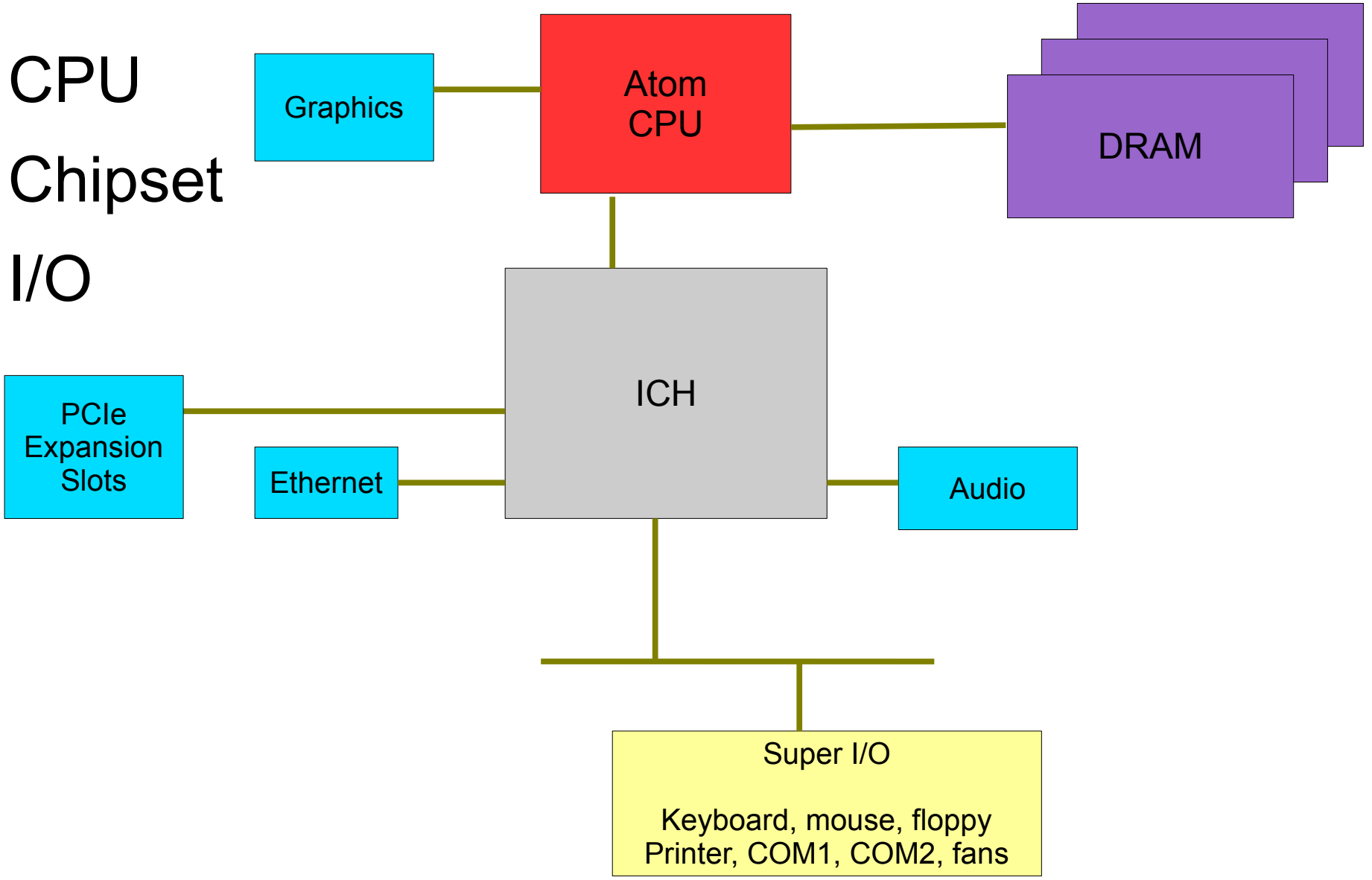
Early PCs

- CPU
- I/O bus



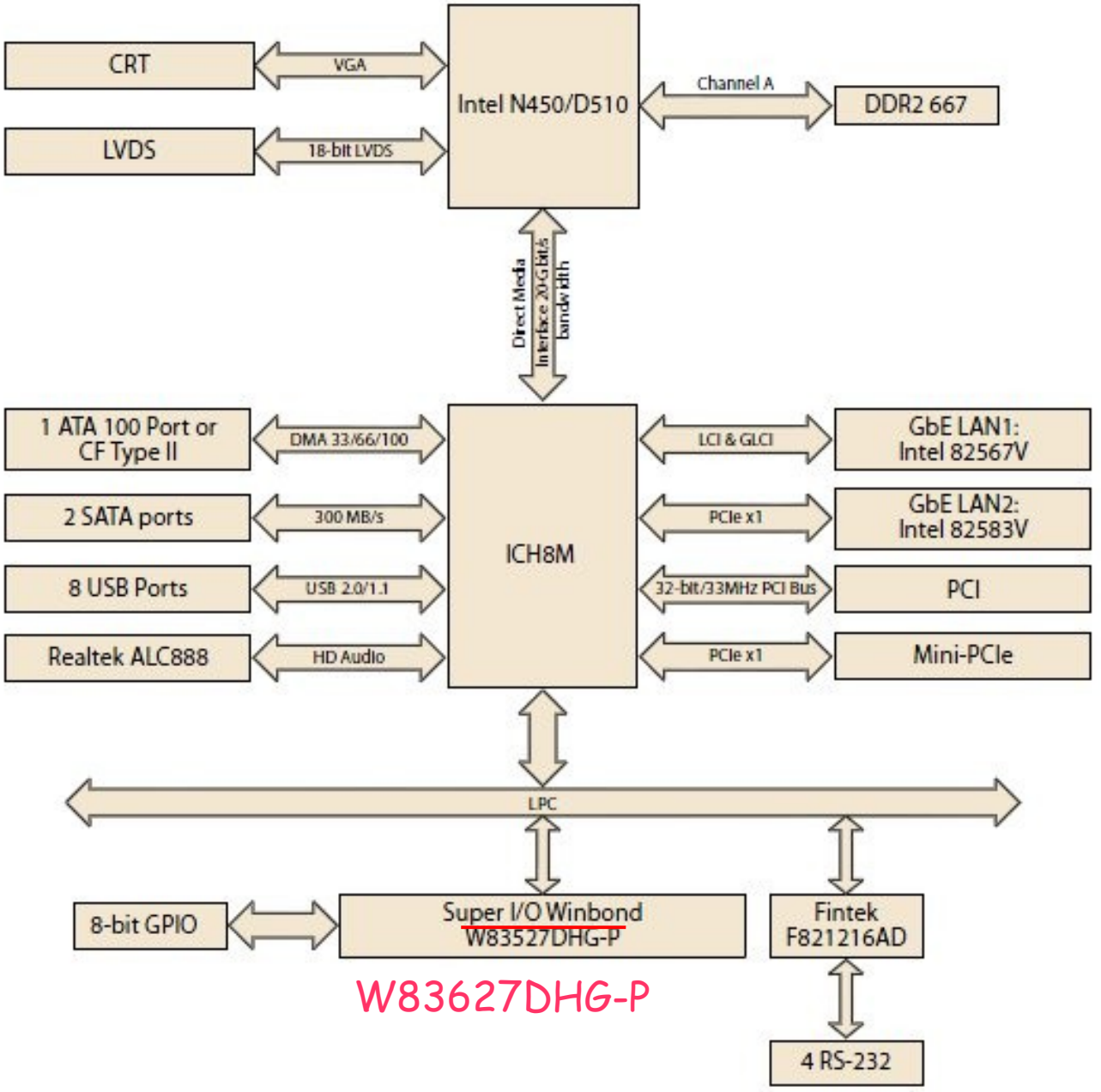
Current PCs

- CPU
- Chipset
- I/O



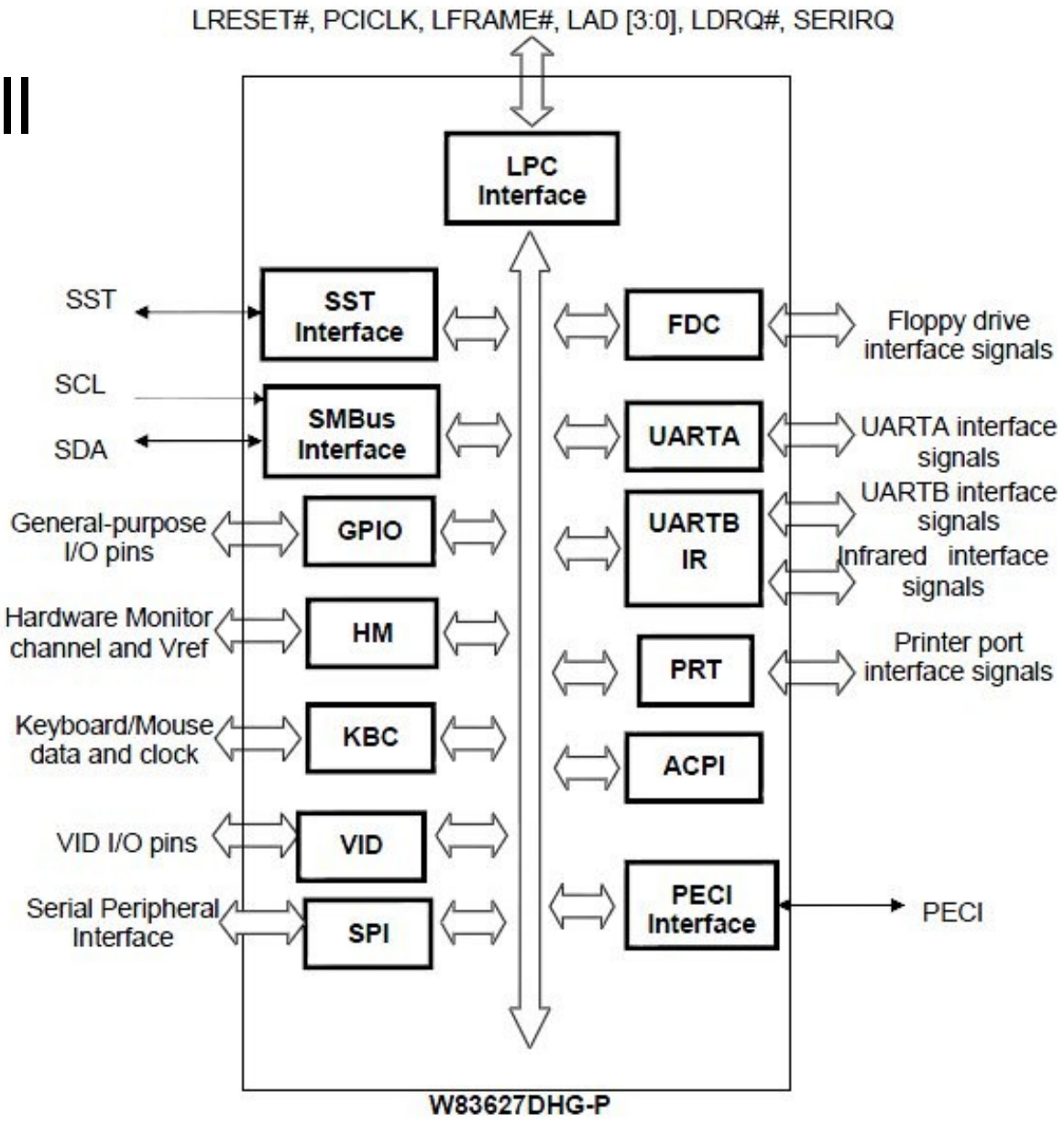
Current PCs

- CPU
- Chipset
- Super I/O



W83627 Super I/O

- Packed full



Complexity in Compression

- Unlock Super I/O
- Select register
- Select internal device
- Select bank
- Select operation mode of multi-use pins
- Set scaling for voltage regulator or sensor
- Read/write values
- Lock up

Many Super I/O chips

- Several vendors
- Slightly different commands

- superiotool
  - User program to inspect and give info
  - Opens /dev/io
  - Pokes for various known chips
  - ... not helpful for unknown chips