Session #7: Device Drivers, Booting the Application

Getting ready to ship

Linux Device Drivers

- Devices treated like files
  - Everything in Linux is a file
  - Device files in /dev/...
- Device Classes
  - Character
  - Block
  - Pipe
  - Network

/dev directory

```
# ls -l /dev
brw-rw----   1 root   disk     3,   0 May  5  1998 hda
brw-rw----   1 root   disk     3,   1 May  5  1998 hda1
brw-rw----   1 root   disk     3,  10 May  5  1998 hda10
                        .
brw-rw----   1 root   disk     3,  64 May  5  1998 hdb
brw-rw----   1 root   disk     3,   0 May  5  1998 hdb1
                        .
lrwxrwxrwx   1 root   root          5 Feb 23  10:00 mouse -> psaux
                        .
crw-rw-r--   1 root   root    10,   1 Feb 23  17:14 psaux
                        .
crw-rw-rw-   1 root   root     5,   0 May  5  1998 tty
crw-------   1 root   root     4,   0 May  5  1998 tty0
crw-------   1 root   tty      4,   1 Feb 23  20:06 tty1
crw-rw----   1 root   uucp    19,   0 Apr 17  1999 ttyC0
```

Major Number

Minor Number

Links

Owner

Group

Assigned Major Device Numbers (excerpt)

Major	Character Devices	Block Devices
0	*unnamed* for NFS, network, etc	
1	Memory (mem)	RAM disk
2		Floppy disks (fd*)
3		IDE hard disks (hd*)
4	Terminals	
5	Terminals and AUX	
6	Parallel interfaces	
7	Virtual consoles (vcs*)	
8		SCSI hard disks (sd*)
9	SCSI tape drives (st*)	
10	Bus mice	
11		SCSI CD-ROM (scd*)
12	QIC02 tape	
13	PC speaker driver	XT 8-bit hard disks (xd*)

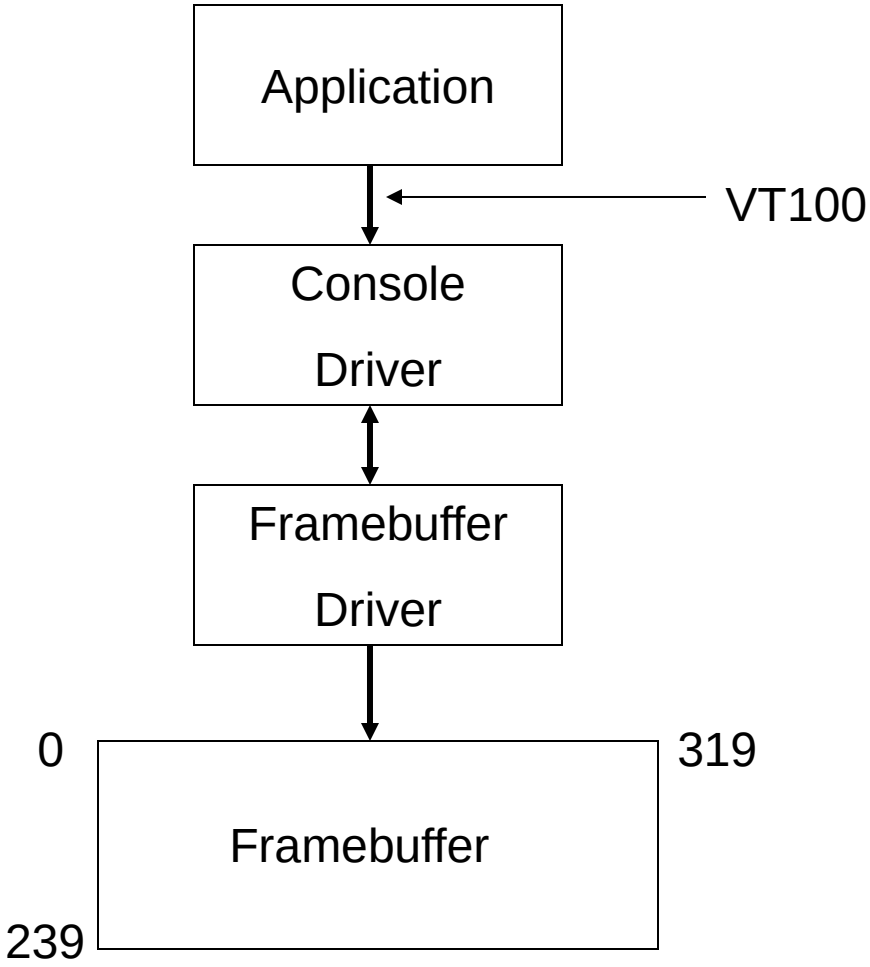
Low-level System Calls

```
int open (const char *path, int oflags);
size_t read (int file_des, void *data, size_t len);
size_t write (int file_des, const void *data, size_t len);
int close (int file_des);
int ioctl (int file_des, int cmd, …);
```

Framebuffer and console drivers

- Framebuffer driver manages bitmapped framebuffer devices
- Console driver manages video terminals using …
- ANSI terminal escape sequences

Framebuffer and console drivers 2



lcdutils.c

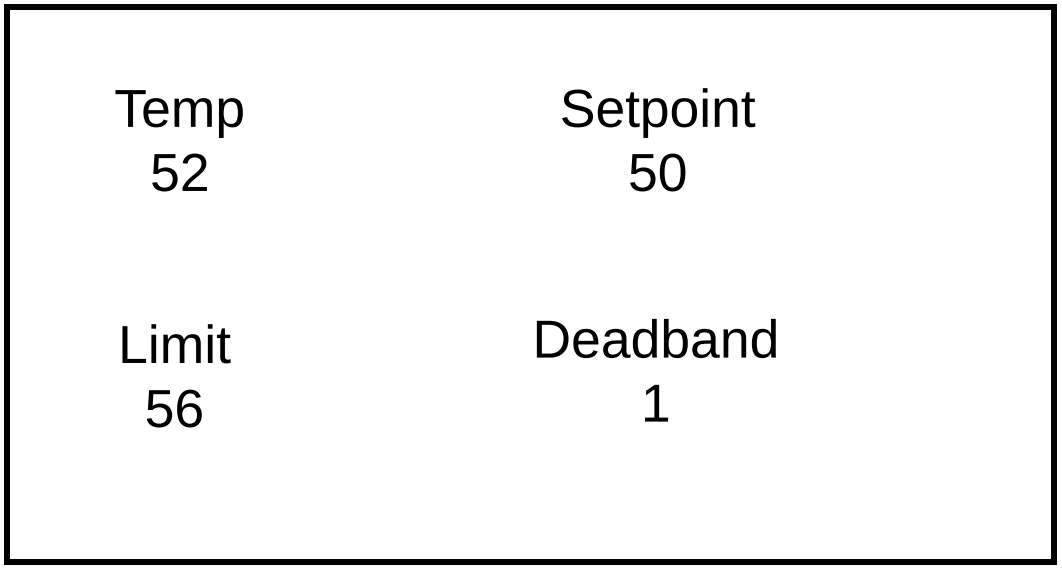
- cd target_fs/home/src/lcd

- int LCD_init (void);
- LCD_erase (int what);
- LCD_set_cursor (int row, int col);
- LCD_write_string (int row, int col, char *string);
- LCD_write_number (int row, int col, int value, int len);
- LCD_backlight (int on);
- LCD_close (void);

lcdtest.c

- Commands
  - s <row> <col> <text>
  - n <row> <col> <number> <width>
  - e
  - b <on | off>
  - q
- make
- ./lcdtest (plug in LCD panel first)

Thermostat Screen Display



Creating LCD thermostat

- Copy thermostat.c from network/
- Add two functions:
  - int init_screen (void)
  - void write_screen (void)
- Call init_screen() as part of initialization
  - Check return value
- Call write_screen() at the end of every loop

Init process

- First process started by the kernel
  - Usually /sbin/init
- Gets its instructions from /etc/inittab
- Executes init script rcS using bash
- Starts console terminal
- Use inittab to start application
  - Or replace /sbin/init

inittab

ID : runlevel: action : process <process arguments>

null::sysinit:/etc/init.d/rcS
ttyS0::respawn:/sbin/getty -L ttyS0 115200 vt100
::ctrlaltdel:/sbin/reboot

Actions

once	execute the process once
wait	execute the process once. Init waits until the process terminates
askfirst	ask the user if this process should be run
sysinit	these processes are executed once before anything else executes
respawn	restart the process whenever it terminates
restart	like respawn
shutdown	execute these processes when the system is shutting down

Edit inittab

- Backup etc/inittab
- Edit inittab
  - #ttySAC0::respawn:/sbin/getty –L ttyS0 115000 vt100
  - ttySAC0::respawn:/home/src/lcd/netthermo_t
- Edit etc/init.d/rcS
  - Comment mount command near bottom

Make YAFFS file system

On host:

- cd ~
- mkyaffs2image-128M target_fs-2451 target_fs.yaffs
- Copy target_fs.yaffs-2451.yaffs to images/Linux on the SD card
- Edit images/FriendlyARM.ini
  - Comment Linux-Kernel
  - Uncomment Linux-RootFs-InstallImage

On the target

- Insert SD card
- Move boot selector toward card edge
- Power up or reset
  - target_fs-2451.yaffs is loaded in NAND
- Move boot selector switch back
- Power up or reset
  - netthermo_t should start automatically

Change it back

- Restore to command line operation
  - Change etc/inittab back
  - Change etc/init.d/rcS back
  - Move the home/ directory somewhere else
  - Make a new file system image
  - Go back to previous slide
  - Move home/ back into target_fs-2451/

Review

- Device drivers
  - Console drivers
  - Framebuffer drivers
- Linux initialization
  - Starting application directly
  - Loading everything in NAND flash