Freescale Technology Forum

Design Innovation.

November 2008

# Hands-on Workshop: Optimizing the MPC5121e Multicore Processor for Multimeida Applications

PC115

**David Liu**

Field Applications Engineer



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# Hands On Workshop: 5121e Multicore Architecture

## Class Objectives:

- Understand the Multi-Core Architecture of the MPC5121e
- Understand the capabilities of the MBX 3D Accelerator
- Build and Deploy Linux on a 5121e ADS using Freescale LTIB
- Create your very own 3D application using the MPC5121e OpenGL SDK and see the results
- Understand the openGL API and the benefits of the MPC5121e OpenGL SDK

## Topics Covered

- MPC5121e, Freescale Linux BSP, OpenGL, MPC5121e OpenGL SDK, 3D Graphics, Freescale LTIB (Linux Target Installation Builder), MPC5121e ADS development boards





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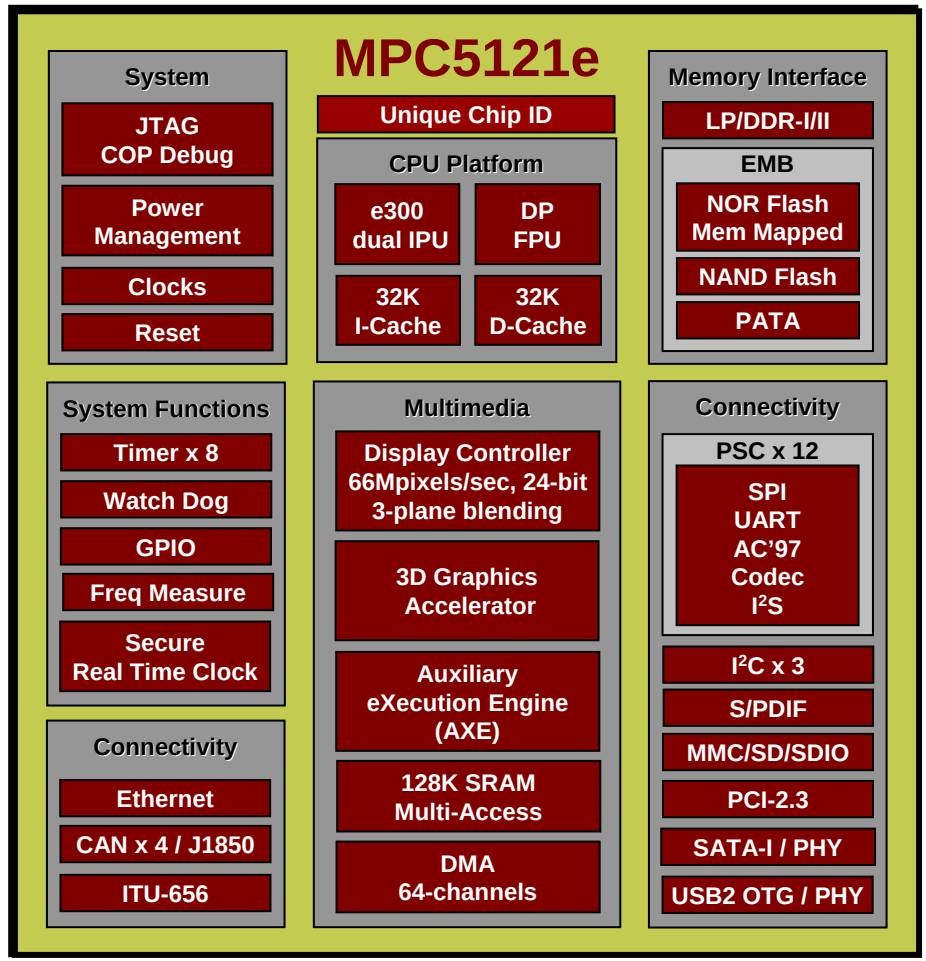
# MPC5121e
## High Performance Multi-Core Processor

- CPU Platform
- PPC e300, 32K I/D-Cache
- Double precision FPU, dual integer units
- Multimedia
- Audio
  - Decode/encode
  - Fully programmable to address other applications
- Graphics
  - OpenVG 1.0
  - OpenGL-ES 1.1
- Display Controller
  - Resolutions up to 1280x720, 24-bit RGB
  - 3 planes with chroma key or a-blending
  - Area descriptor windowing & animated cursor support
- Memory Interface
- 16/32-bit DDR-I/II & MobileDDR-I controller
- EMB – External Memory Bus (transaction multiplexed)
  - 8/16-bit NAND flash controller
  - Non/ALE-muxed NOR flash & memory mapped I/O controller
  - PATA controller (UDMA–5)
- Connectivity
- 32-bit PCI-2.3 controller
- SATA-I controller with integrated 1.5GHz PHY
- 2x USB 2.0 OTG with ULPI interface, 1x High Speed PHY
- 12x PSC: I²S, AC'97,Codec, SPI & UART
- S/PDIF controller
- MMC/SD/SDIO controller
- 3x I2C controller
- 10/100 Base-T ethernet controller
- 4x CAN2.0A/B controller
- ITU-656 video input port
- Specs Summary:
- CPU Speed: 400 MHz, 1.99DMIPS/MHz
- Package: PBGA 27x27mm – 1mm pitch
- Temp: -40 to 85 C




***MPC5121VY400B***

***AECQ-100 and Industrial***





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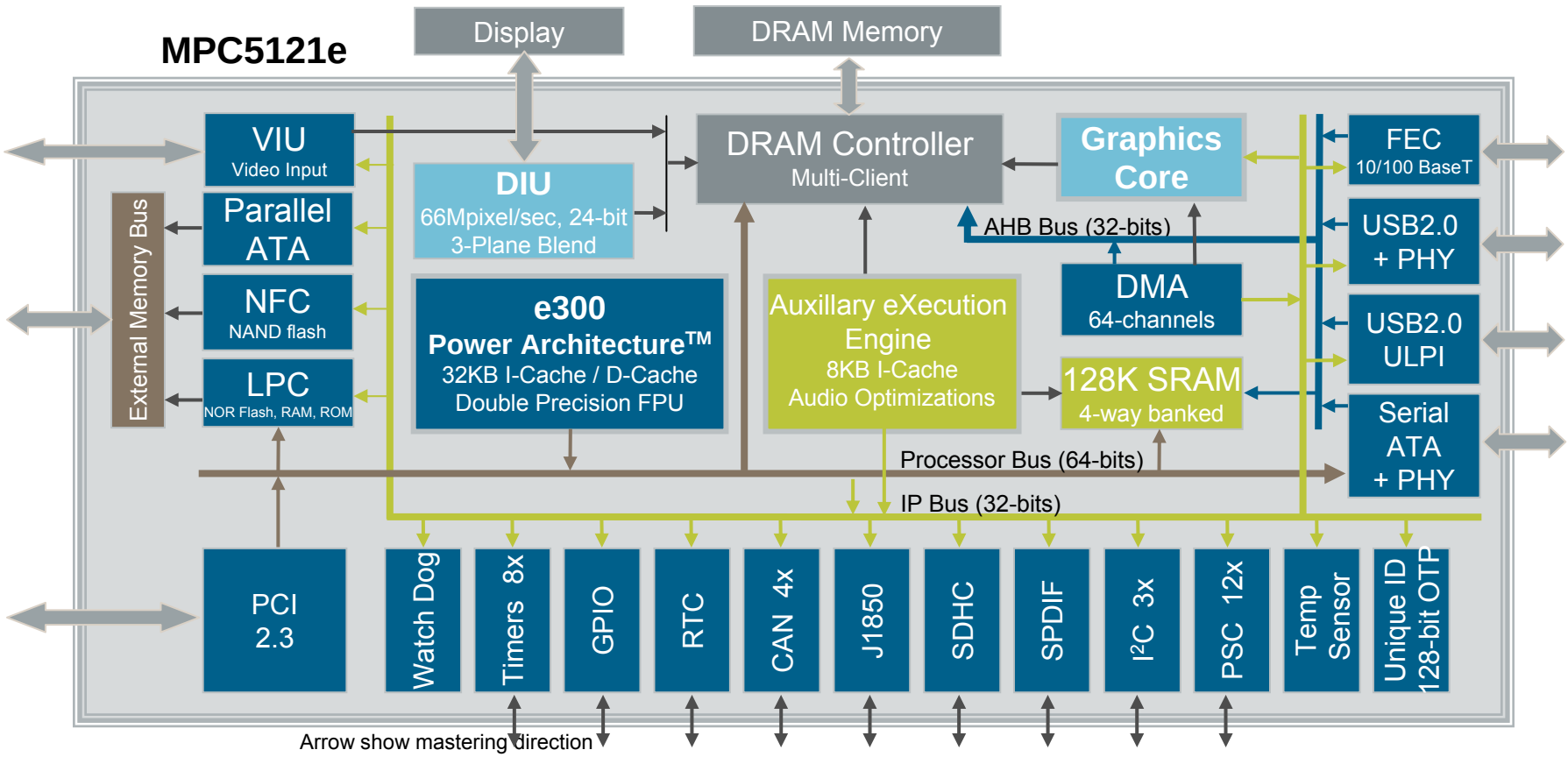
# MPC5121e SoC Architecture




- Multi-core architecture improves the power/performance trade-off through more efficient computing
- Multi-client DRAM controller architecture achieves a simulated throughput of 1100Mbytes/sec
- Peripheral integration which absorbs system BOM cost across many applications





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# Example 3D Graphics Application


Picture Source: http://www.linuxdevices.com/news/NS6146656870.html
Courtesy of Sony





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# Multiple Graphics Layers






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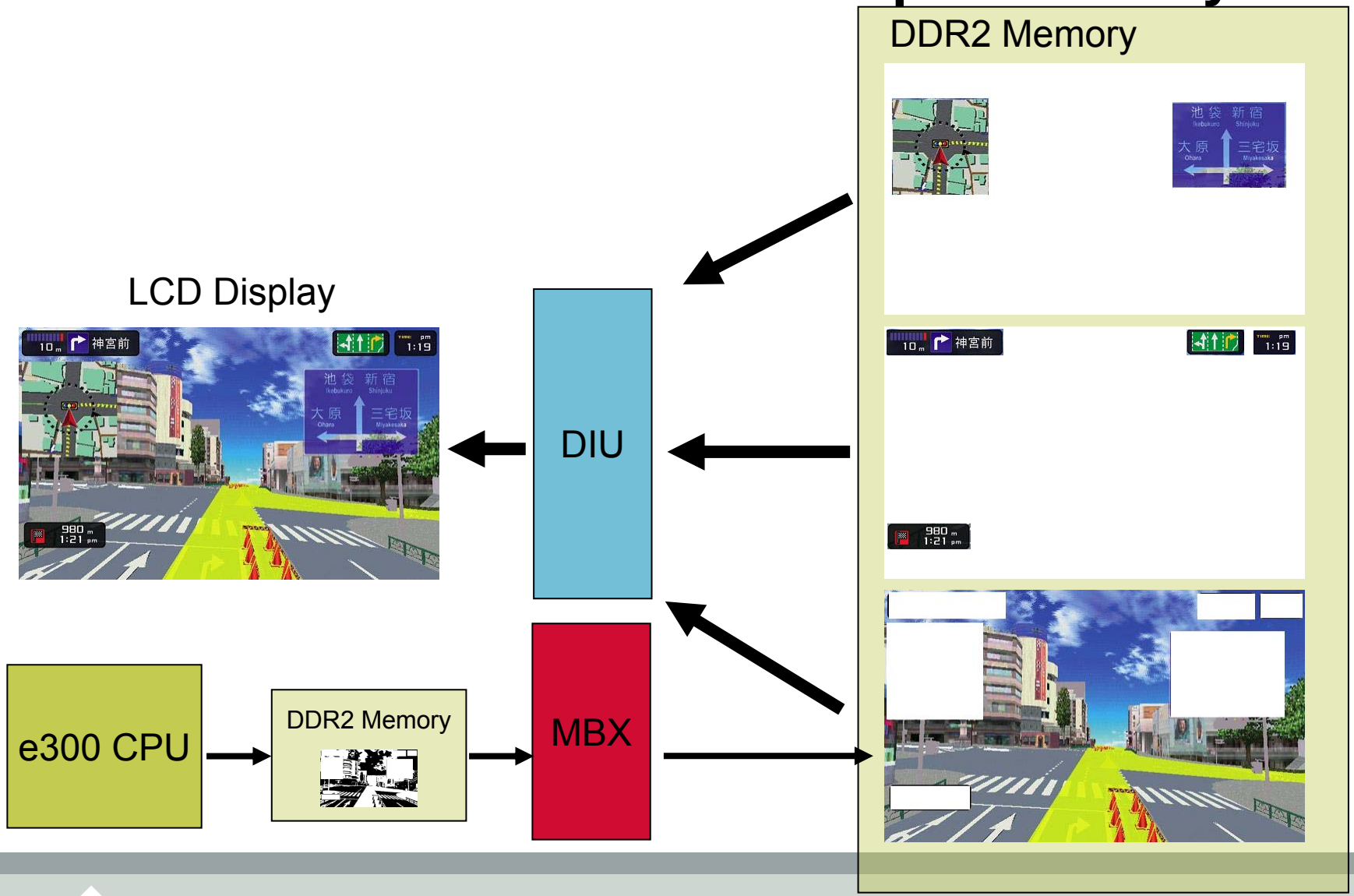
# MPC5121e Graphics Subsystem





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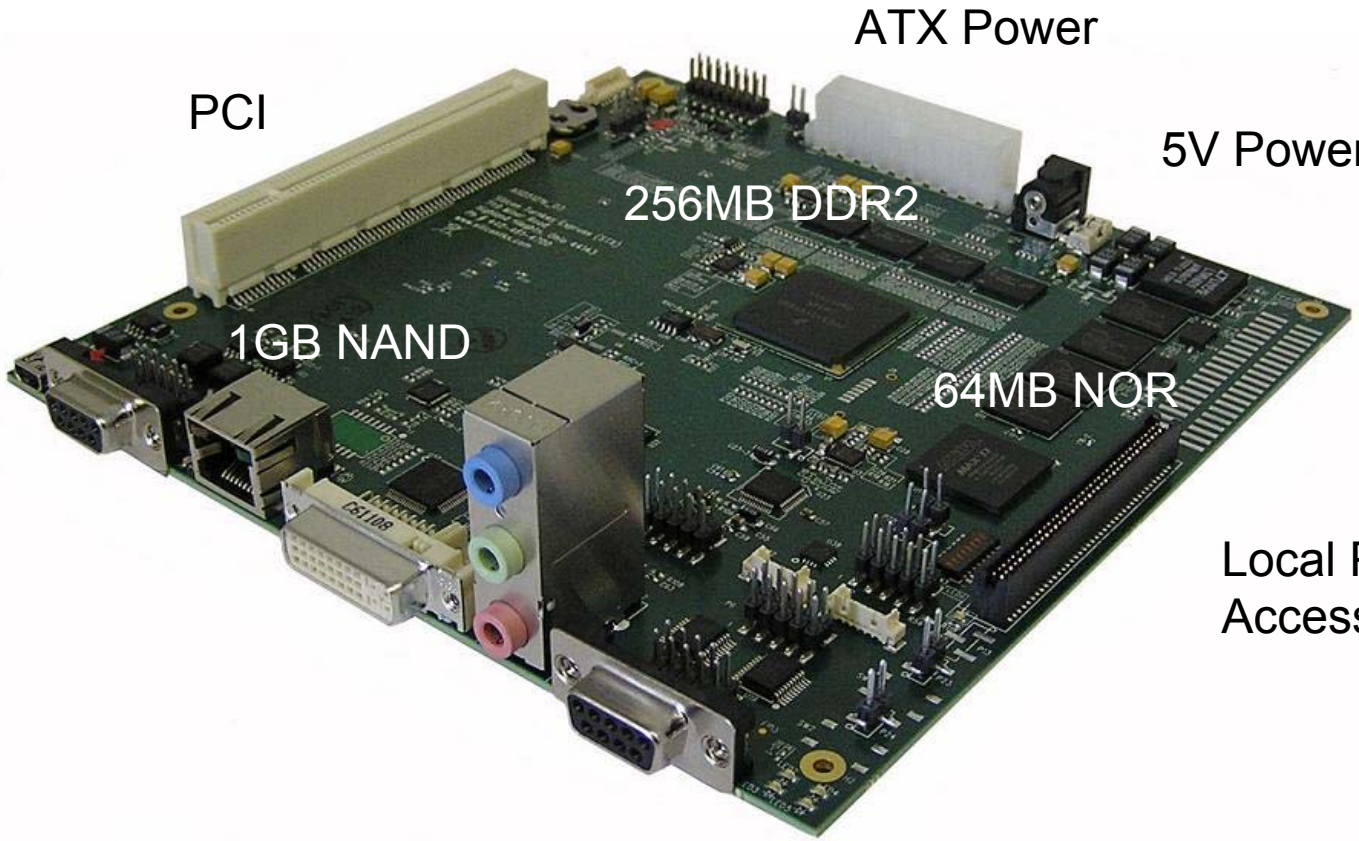
# Sample Slide: Text + 1 Graphic

- What is the MPC5121e ADS?





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# Linux BSP Features

| DevTech Linux BSP | Planned Features | Beta | Rev 1 RTM Features | Rev 2 RTM Features |
|---|---|---|---|---|
| Linux Basis | | 2.6.22 | 2.6.24 | 2.6.24 |
| Chip Basis | | M34K | 2M34K | M36P |
| Chip Unofficial AKA | | Rev 1.0 | Rev 1.5 | Rev 2.0 |
| Date | | 12/10/2007 | 5/30/2008 | TBD |
| ADS Board Basis | | Rev 2B | Rev 3 | Rev 4? |
| SW Component | | | | |
| LPC | Yes | Yes | Yes | Yes |
| DDR | Yes | Yes | Yes | Yes |
| NOR flash | Yes | Yes | Yes | Yes |
| IPIC | Yes | Yes | Yes | Yes |
| UART | Yes | Yes | Yes | Yes |
| PCI (server) | Yes | | Yes | Yes |
| FEC (ethernet) | Yes | Yes | Yes | Yes |
| DMA | Yes | Yes | Yes | Yes |
| PSC-AC97 | Yes | Yes+Patch | Yes | Yes |
| PATA | Yes | Yes | Yes | Yes |
| IIC | Yes | Yes | Yes | Yes |
| DIU | Yes | Yes | Yes | Yes |
| JTAG | Yes | Yes | Yes | Yes |
| RTC | Yes | | Yes | Yes |
| SATA | Yes | | Yes | Yes |
| USB (host, client mass storage) | Yes | Yes | Yes | Yes |
| CAN | Yes | | Yes | Yes |
| NFC | Yes | Yes | Yes | Yes |
| PSC-SPI | Yes | Yes | Yes | Yes |
| Power: Deep Sleep | Yes | | Yes | Yes |
| Power: Hibernate | Yes | | 6/30/2008 | Yes |
| PSC-PCM | Yes | | | Yes |
| SPDIF | Yes | | | Yes |
| PSC-IIS | Yes | Patch | Yes | Yes |
| SDHC | Yes | | Yes | Yes |
| BDLC | No | | | |
| WDT | No | | | |
| GPT | No | | | |
| PCI Target | No | | | |
| VIU | Rev 2 | | N/A | Yes |
| Kernel real-time patch | Yes | | | Yes |
| Boot-time critical services | Yes | | | Yes |
| Fast Boot | Yes | | | Yes |
| OpenGL-ES | Yes | 5/15/2008 | post RTM | Yes |
| OpenVG | Yes | 5/15/2008 | post RTM | Yes |
| AXE Scheduler / gstreamer | Yes | | Yes | Yes |
| AXE Codecs | Yes | | Yes | Yes |
| Qtopia 4.3 | Yes | | | Yes |





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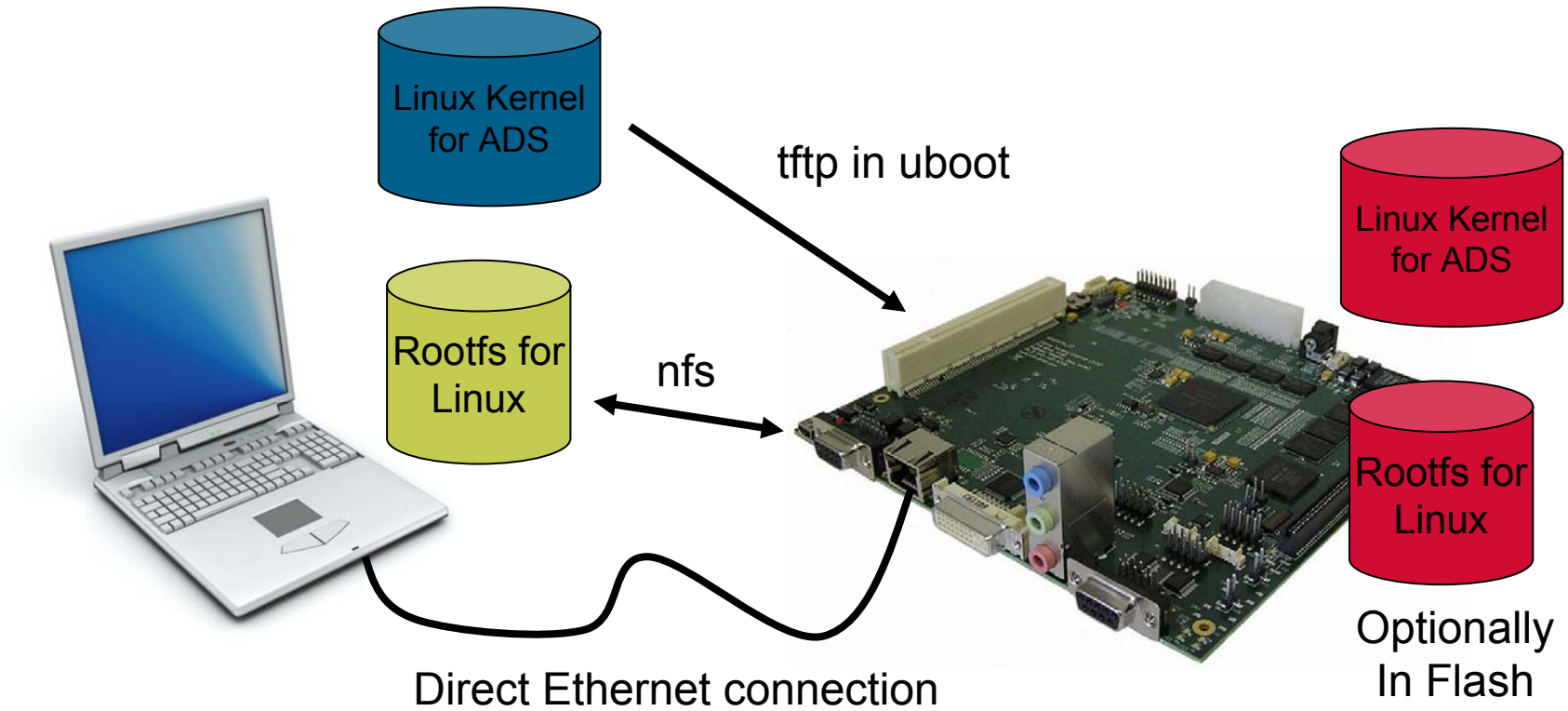
# Development Environment Diagram




Laptop running WindowsXP
VMWare with a Debian Linux Installation





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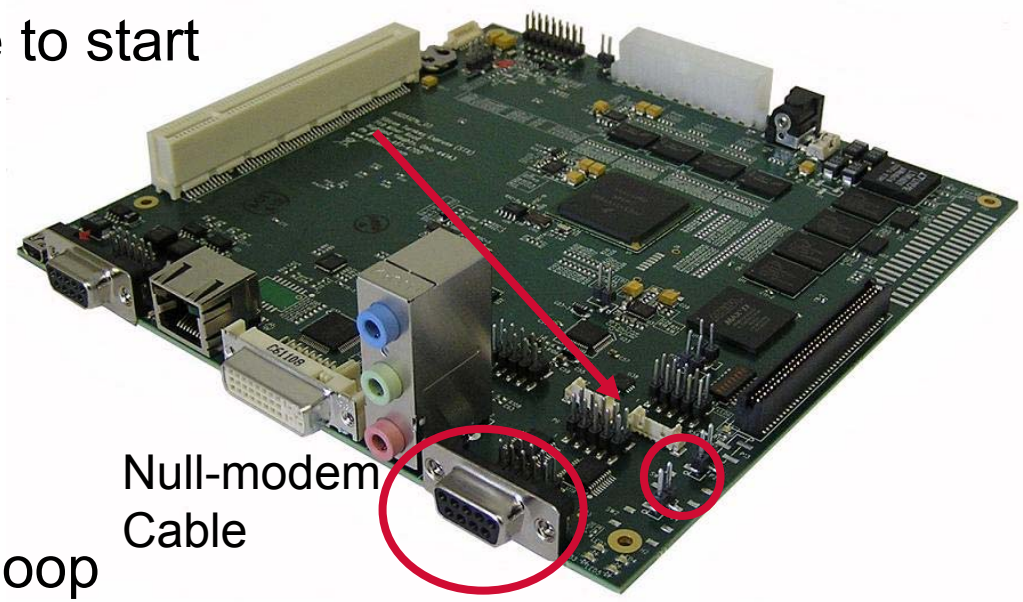
# Check the ADS board at your station

- Make sure that the board is plugged into the monitor
- Open hyperterminal and plug in serial cable
- Plug in board
- Press button located here to start




At Linux prompt type demoloop





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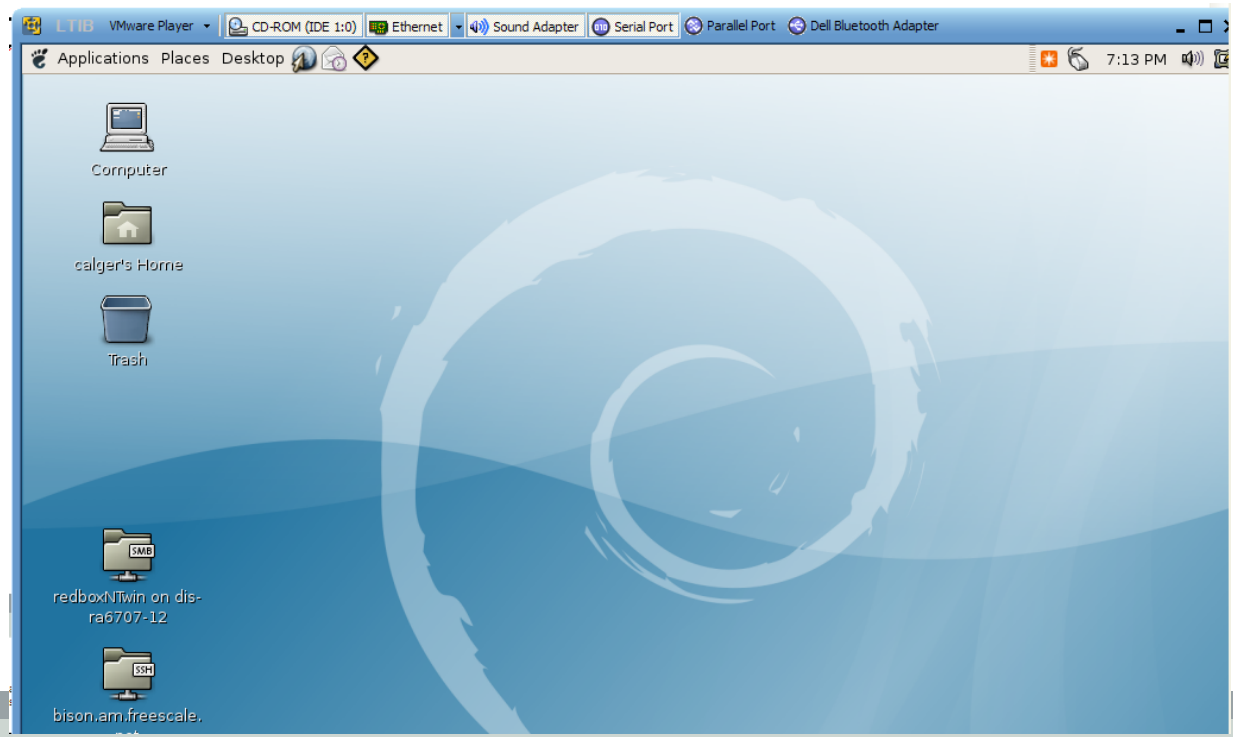
# VmWare and Debian

- Vmware
  - www.vmware.com – look for vmplayer
- Debian
  - www.debian.org – create an install disk by downloading .iso image





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# Install Host Networking Protocols

- Look for NFS in Synaptic Package Manager
  - Used for the target root file system
  - Setting up NFS also requires an entry in the /etc/.exports file
  - Line to allow directory /tftpboot for nfs server

```
/tftpboot/rootfs *(rw,no_root_squash,async)
```

- Look for tftp in Synaptic Package Manager
  - Used to download kernel in u-boot
  - Edit /etc/xinetd.d/tftp

```
service tftp
{
        disable         = no
        socket_type = dgram
        protocol        = udp
        wait             = yes
        user                 = root
        server               = /usr/sbin/in.tftpd
server_args   = /tftpboot
}
```

# What is LTIB (Linux Target Image Builder)?

- Freescale development for building and deploying Linux Board Support Packages
- Information on running and adding to the LTIB BSP Package Pool is found at http://www.bitshrine.org
- LTIB source can be found at http://cvs.savannah.nongnu.org

# Installing LTIB

- Download LTIB from the MPC5121e Product Summary Page on www.freescale.com
- Installed to /home/freescale/ltib-mpc5121ads-20080528 directory
- LTIB (Linux Target Image Builder) contains
  - U-boot source
  - Linux Kernel version 2.6.24
  - Common Linux applications
  - Common and MPC5121e-specific hardware Drivers
  - Configuration tool to help select the right packages
    - Many packages require other packages including certain versions
    - LTIB's value is making this process easier to manage

# Installing the OpenGL Library

- The Latest MPC5121e-MBX OpenGL driver from ALT Software comes as a tar file of some directories.
- They are uncompressed in the OpenGL-ES_ALPHA directory under home/freescale
- This library of files is  needed to build openGL applications and to run those applications on the MPC5121e target
  - Therefore there are a couple of copies of these directories on the system
    - <ltib_dir>/config/platform/mpc5121ads/merge – makes sure that openGL files are included in the root filesystem of the target system
    - <SDK_dir>/Builds/OGLES/LinuxMPC512/Lib – OpenGL library copied here because this is where the SDK makefiles expect it to be

# Host Environment Variables

- One environment variable is needed to build these demos and training samples

`export PLATFORM=LinuxMPC512` -> will likely change this to LinuxMPC5121e in later SDK

- You can put it in your home directory .profile if you like, but go ahead and type that now.

# Modifications required for LTIB for openGL driver

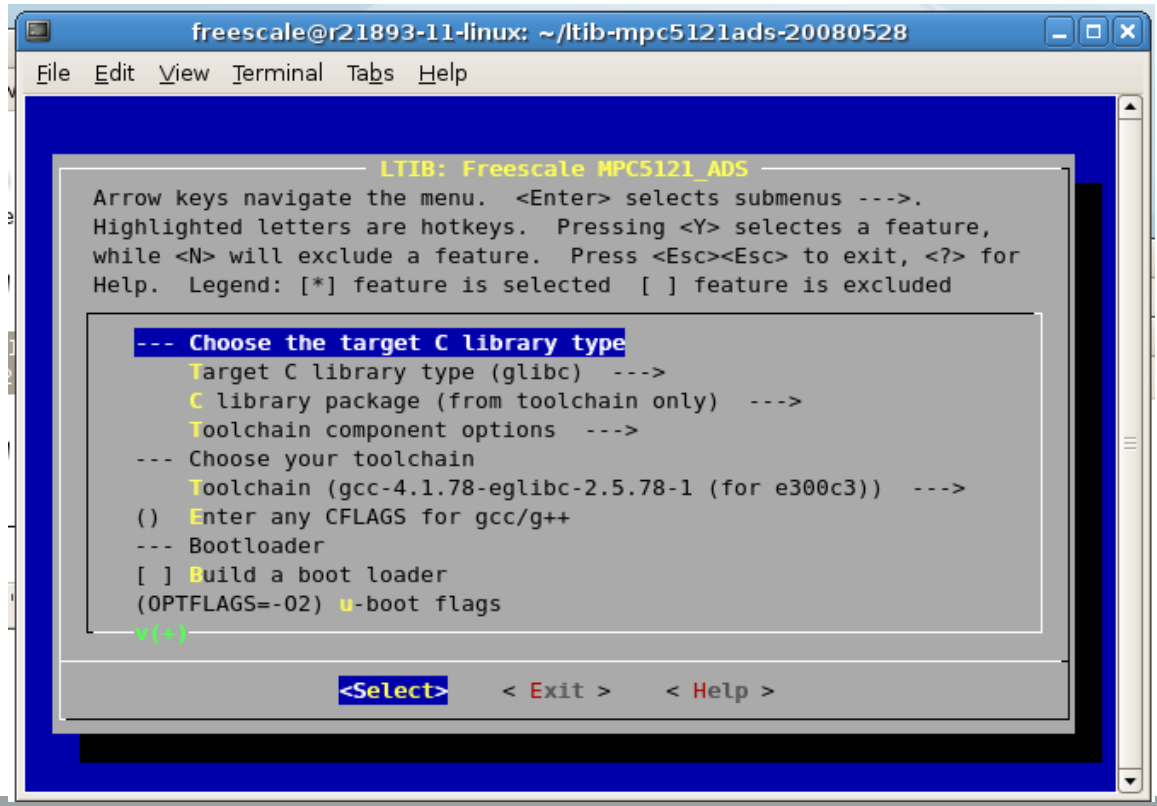
- The May 2008 LTIB release requires a couple of extra patches to the MPC5121e Display Interface Unit (DIU) driver
- These have already been incorporated into your systems
  - .spec file goes in <ltib_dir>/dist/lfs5.1/kernel
  - 2 Patch files go in <ltib_dir>/opt/freescale/pkgs
- The next revision of the MPC5121e LTIB will not require these modifications

# Hands-On

- Start Fresh by cleaning out the built objects

  ./ltib –m clean

./ltib –configure
This will being up the screen that will allow you to configure ltib





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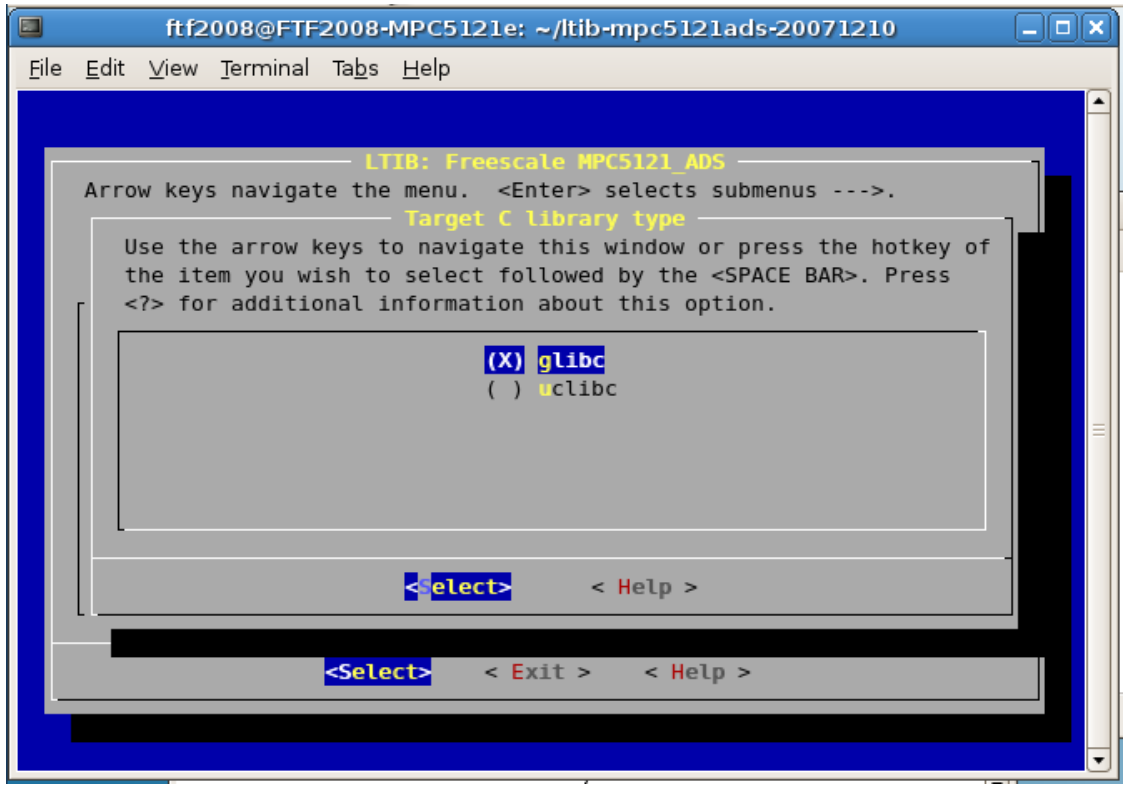
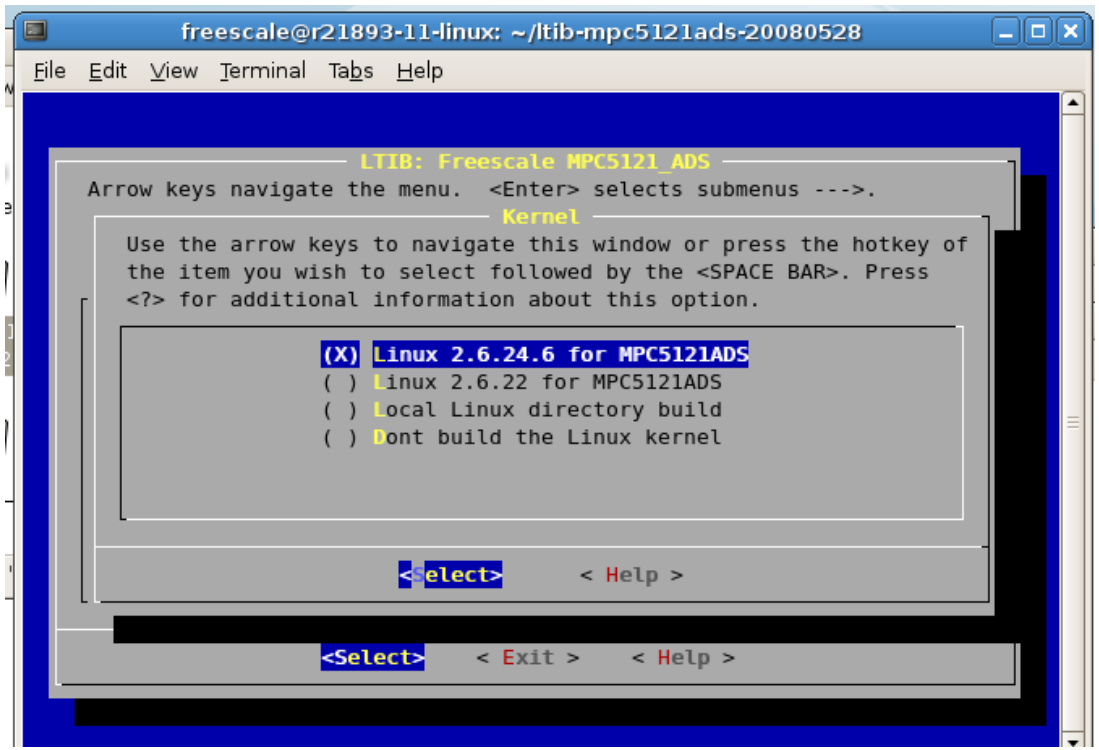
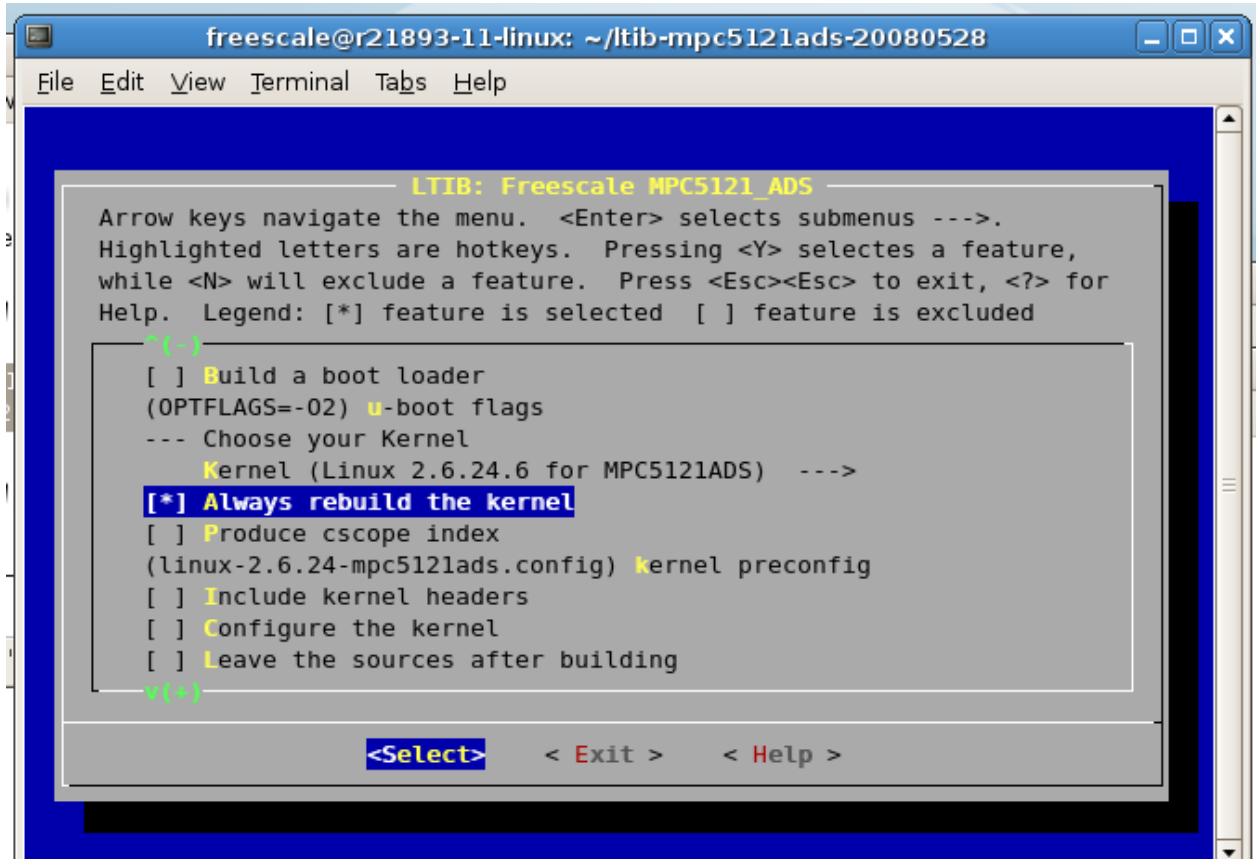
Make sure glibc is selected. Uclibc is a smaller library, but does not have all of the features.



You can see the options for what kernel to build here



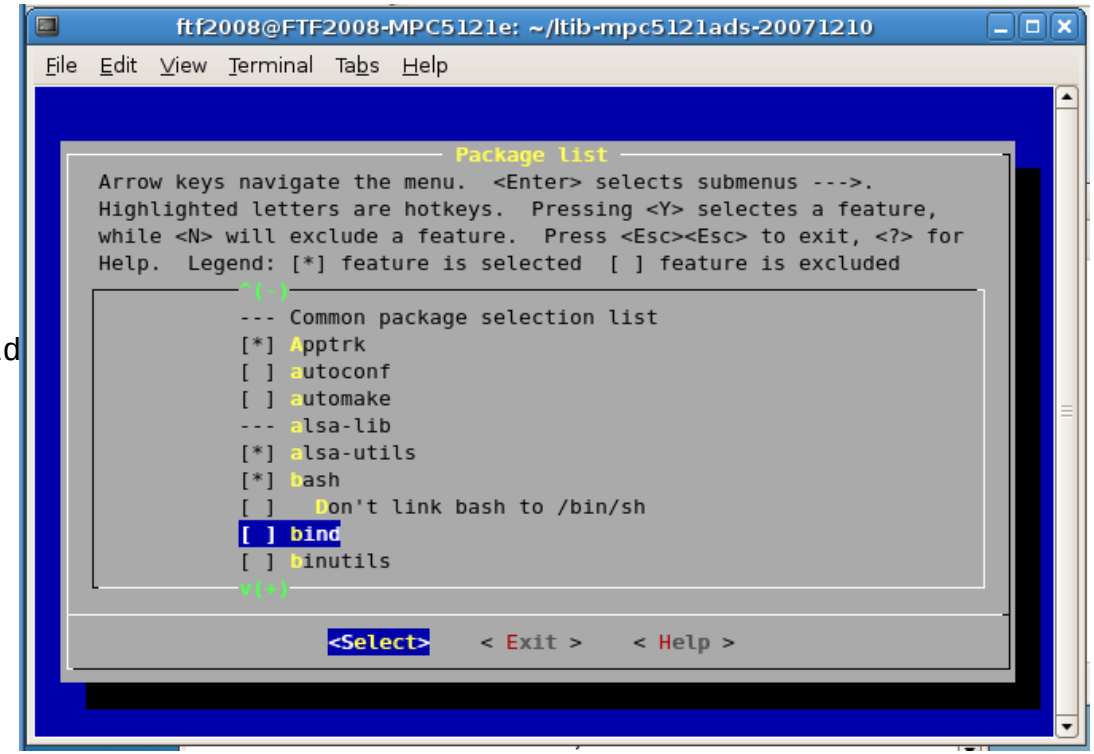
Configure the kernel should be checked so it can be configured during the build.




Make sure that these options are selected. You may want Kernel headers if you are developing an application that uses the OS calls.
If you do not leave the sources, they will be removed after building. There is another way to see the sources though: ./ltib –m prep –p kernel

Packages –
Common Packages
Make sure these are selected:

```
Apptrk
Alsa-utils
Bash
Busybox
          select configure at build
Ethtool
Gdb
Gdb run native
Gstreamer with good and bad
Hotplug
I2c-tools
Inetutils
Madplay
Mtd-utils
Ncurses
Net-tools
Skeleton base files
Tinylogin
```



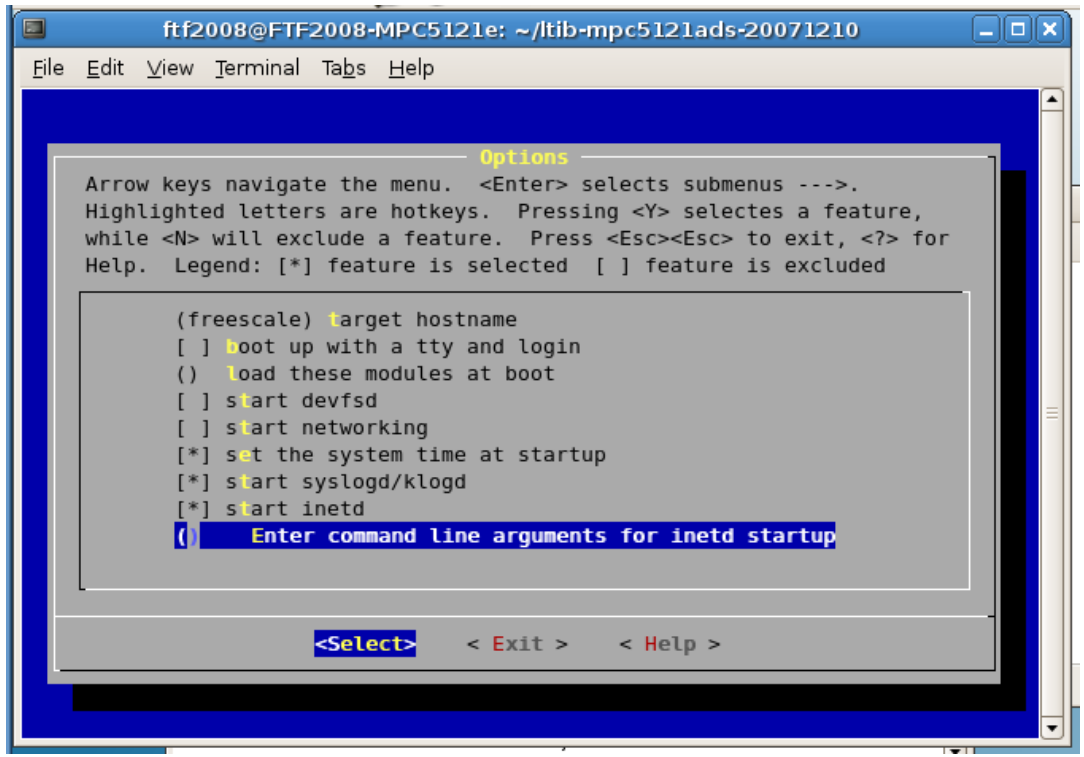

Ltib makes sure all dependencies are met

Back at the Main Menu
Look under Options

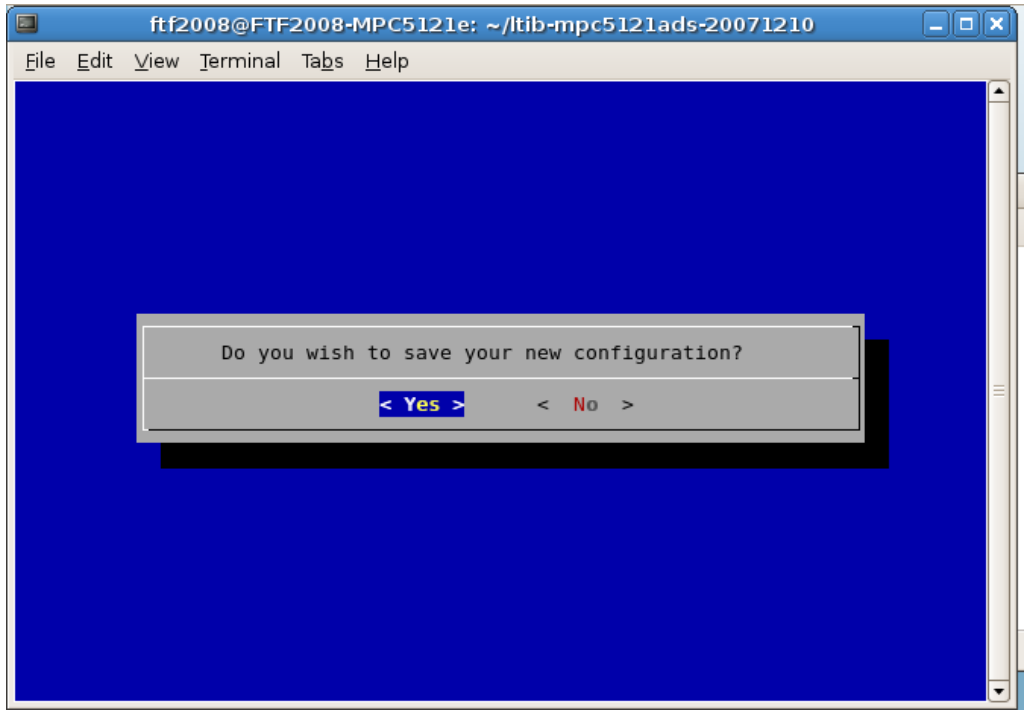
These are options that can happen at boot time.

Networking is not selected because uboot can handle that by passing arguments to the kernel.

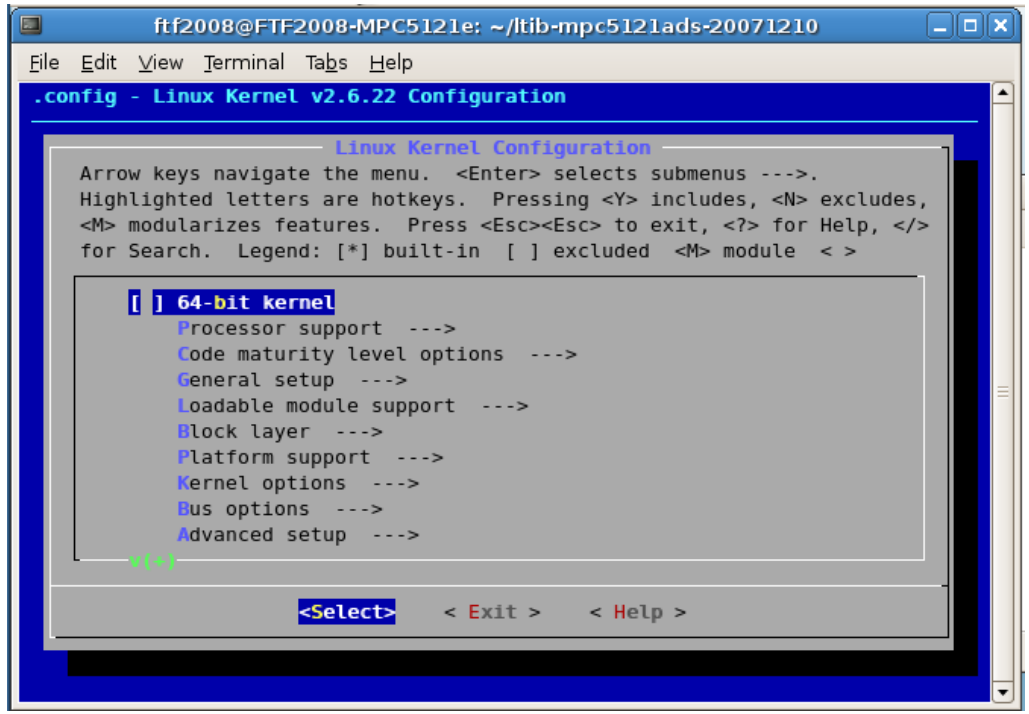
This is what is done in this workshop.



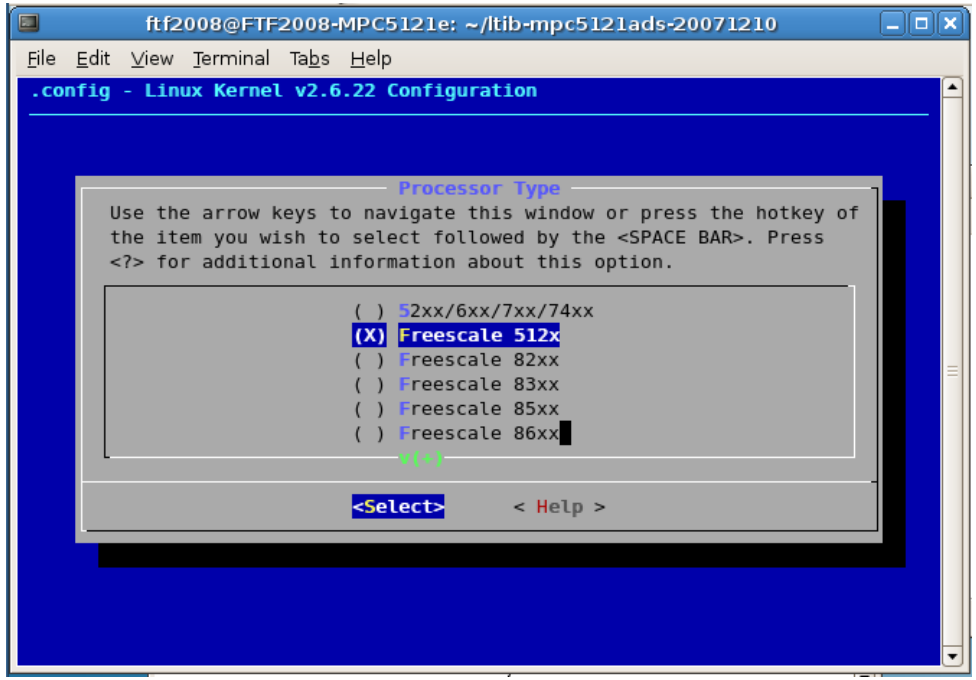
Exit and save the configuration



This screen should come up next. Here you can select some options and setup for the kernel, and more importantly to configure what drivers should be included.



This should already be correct, but make sure that the MPC512x is selected.

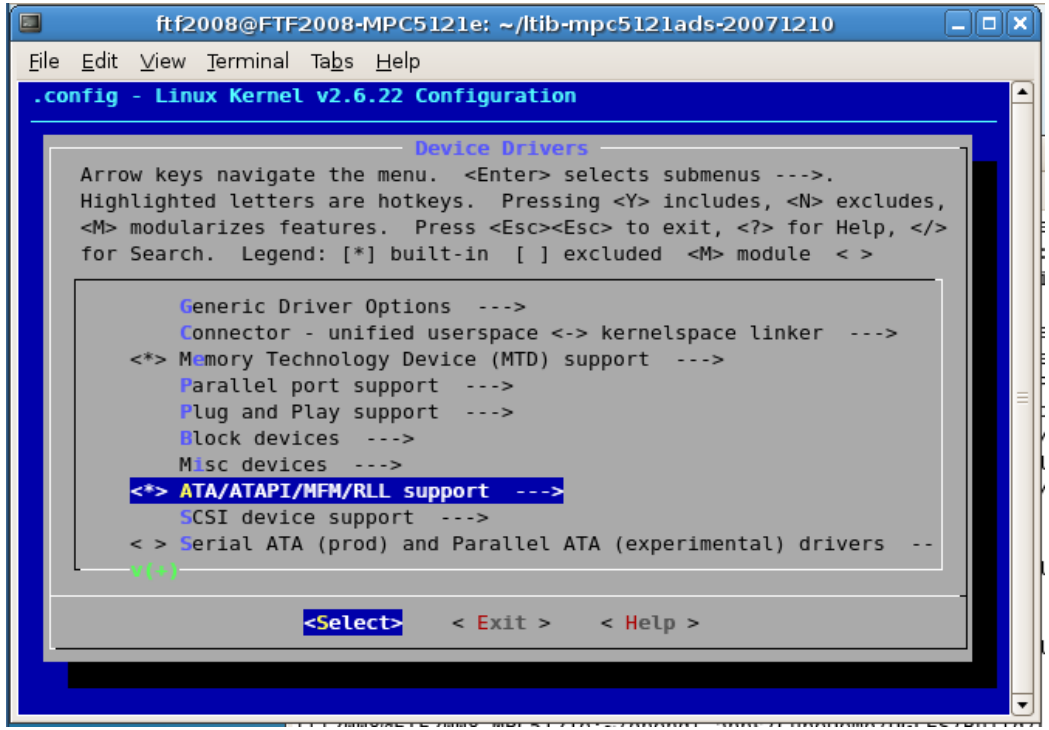


# Hands-On

Make sure to uncheck the ATA support.

Otherwise, the boot up sequence will try to find a hard drive that is not there.

It helps boot time dramatically.





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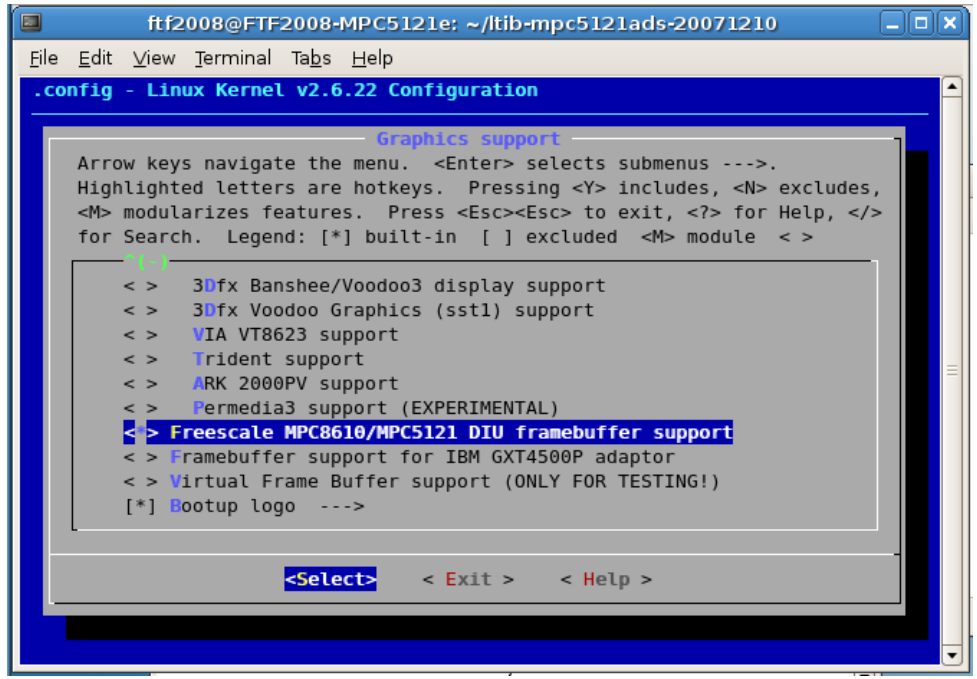
Make sure under

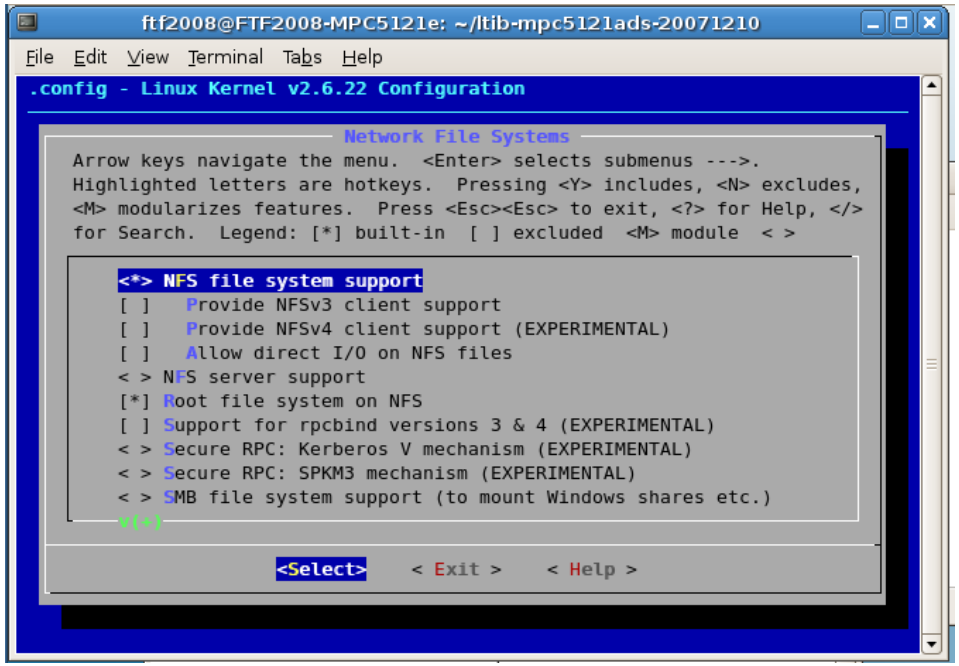
Device Drivers /

Graphics Support /

That the DIU framebuffer support is selected



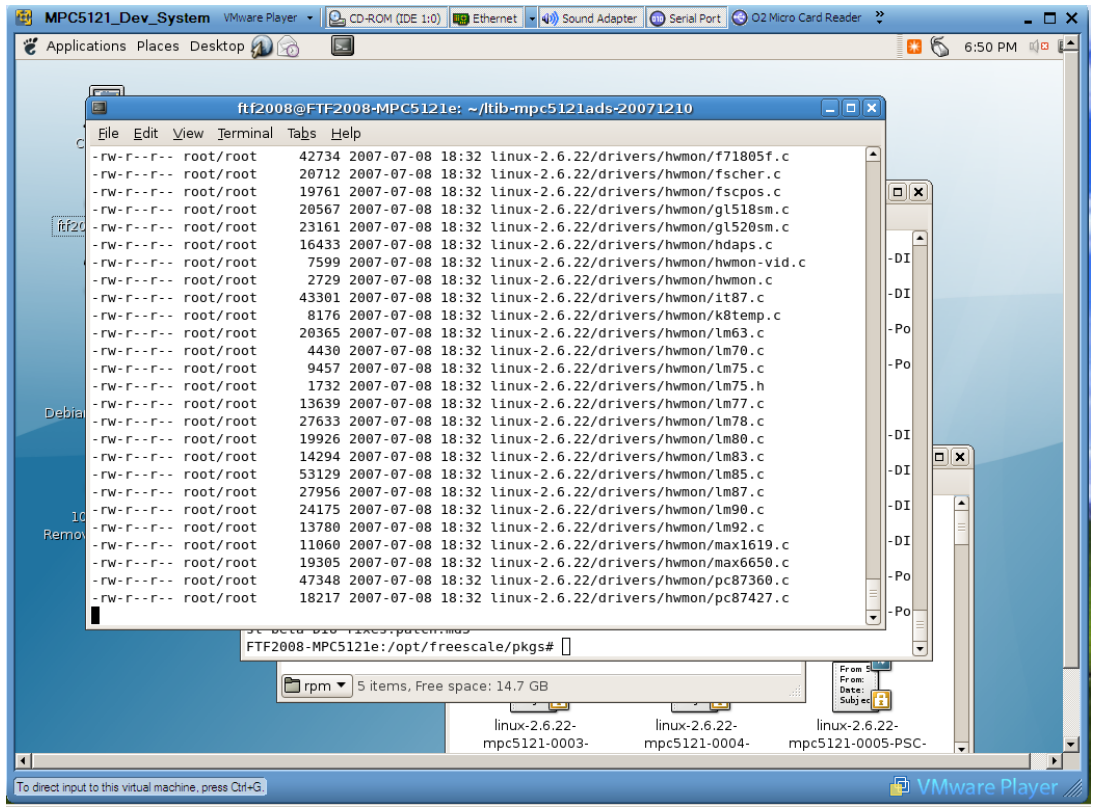
NFS file system support should be selected under Network File Systems



# Hands-On

The kernel should build after exiting this menu.

This should take about 6 minutes, so what is actually happening here….





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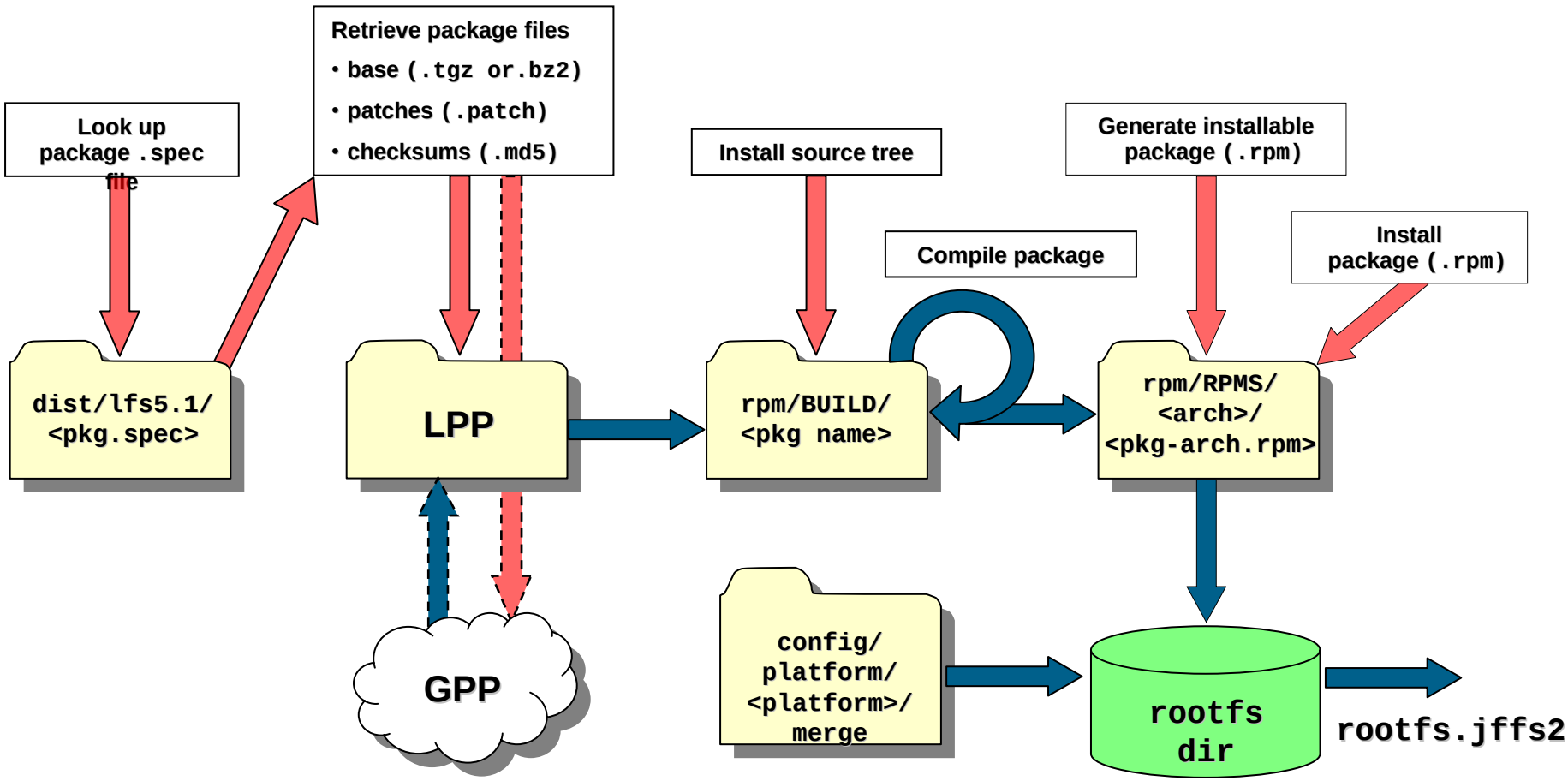
# Building





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# Hands-On

->su (password is root)

->cp <ltib_dir>/rootfs/boot/uImage to /tftpboot

->cp <ltib_dir>/rootfs/boot/mpc5121ads.dtb to /tftpboot

->cd <ltib_dir>/rootfs/

-> vi .profile  (these are needed on the target to find and start openGL library)

```
export LD_LIBRARY_PATH=/usr/lib
/etc/init.d rc.pvr start
```

->exit

This puts the kernel binaries into the directory that the ADS will look for when booting over a network.

# Configuring the ADS board

- Start the board
- Before Linux loads from flash memory press a key
- To check for connection type ping 169.254.43.213 or $serverip depending on what the ip address is.
- Type run net_nfs to boot

# Let’s build our own application

- Make sure you are NOT root
- Go to ~/OpenGL-ES_SDK/SDKPackage/Demos/Vase/OGLES/Build/LinuxGeneric
- Type make CommonLite=1
- Go to ../LinuxMPC512/CommonLite/Release
- Su for root access
- Copy OGLESVase /home/freescale/<ltib_dir>/rootfs/home
- Back to TeraTerm and go to /home and type /home/OGLESVase

# Program Flash

- Copy openGL application to ~/<ltib_dir>/config/platform/mpc5121eADS/merge directory
- ./ltib --deploy
- Creates jffs2 filesystem in the ltib directory
- Copy rootfs.jffs2 to /tftpboot
- Run flash script in teraterm:
  - uImage (kernel)
  - mpc5121ads.dtb (device tree binary)
  - Rootfs.jffs2 (filesystem)
- Reboot board

- Now everything is running out of the flash on the ADS

# U-boot Flash Commands

```
tftp rootfs.jffs2 0x200000
protect off fc040000 fe4fffff
erase fc040000 fe4fffff
cp.b 200000 fc040000 $filesize
protect on fc040000 fe4fffff
tftp uImage 0x200000
protect off ffc40000 ffdfffff
erase ffc40000 ffdfffff
cp.b 200000 ffc40000 $filesize
protect on ffc40000 ffdfffff
tftp mpc5121ads.dtb 0x200000
protect off ffec0000 ffefffff
erase ffec0000 ffefffff
cp.b 200000 ffec0000 $filesize
protect on ffec0000 ffefffff
```

# Related Session Resources

## Session Location – Online Literature Library

*http://www.freescale.com/webapp/sps/site/homepage.jsp?nodeId=052577903644CB*

## Sessions

| Session ID | Title |
|---|---|
| | |
| | |
| | |

## Demos

| Pedestal ID | Demo Title |
|---|---|
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| | |
| | |


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