```
fb0: Panel0 fb device registered successfully.
fb1:  fb device registered successfully.
fb2:  fb device registered successfully.
fb3:  fb device registered successfully.
fb4:  fb device registered successfully.
```

3. Test Xwindow

```
p1022ds ~ # startx &
```

7.4.1.12 How to add X11 to rfs

```
x11 depends "x11-common ,twm,xterm, xclock"  packages
 so add  IMAGE_INSTALL_append_p1022ds = "
 ${XSERVER} \
 x11-common\
 twm \
 xterm \
 xclock \
 xauth \"
in  fsl-image-full.bb

bitbake  fsl-image-full
```

7.4.1.13 Known Bugs, Limitations, or Technical Issues

Because the local bus and DIU is multiplex, so after boot up the uboot with enabling DIU, can't access the NAND flash, just access the NAND flash when disabling the DIU. If booting the board from NAND flash, please don't enable DIU.

As for NOR flash, only "saveenv" command is supported, u-boot do some special operation to access NOR flash while enable DIU, but DIU can not display correctly during access NOR flash.

In Linux, if the DIU is enabled, the NOR and NAND flash are disabled.

7.4.1.14 Supporting Documentation

N/A

7.4.2 DCU Display Device Driver User Manual

7.4.2.1 Description

This manual describes how to use the Two Dimensional Animation and Compositing Engine (2D-ACE or DCU) and frame buffer on TWR-LS1021A board.

7.4.2.2 Dependencies

Hardware:	Freescale TWR-LS1021A board and DCU
Software:	Linux 3.12+ & U-boot v2014.01

7.4.2.3 Module Loading

The DCU device driver supports kernel built-in and module.

7.4.2.4 Jumper Configuration

J19 ◊ Jumper in position 1-2 or 2-3: Lpuart.

J20 ◊ Jumper in position 1-2 or 2-3: Lpuart.

NOTE

These two jumpers are only useful when debuging the Uboot or Kernel using lpuart, because when the DCU is active, the uart must be disabled.

7.4.2.5 RCW configuration

```
UART_EXT=4
QE-TDMA=6
QE-TDMB=6
```

Or you can just build the following binary image:

board	RCW binary
TWR-LS1021A	ls1021atwr/SSR_PPN_20/rcw_1000_dcu.bin

7.4.2.6 U-boot Configuration

Please use ‘ls1021atwr_lpuart_config’ to build the uboot.

Runtime options.

Env Variable	Description	Sub Option		Option Description
bootargs	Kernel command line argument passed to kernel	HDMI	console=ttyLP0,115200 hdmi	select LPUART0 as the system console
		LCD	console=ttyLP0,115200	

7.4.2.7 Kernel Configure Options

Tree View

Below are the Kernel Configure Tree View options need to be set/unset while doing "make menuconfig" for kernel and enable DCU/HDMI drivers and Linux Penguin Logo picture.

```
Device Drivers  --->

   < > Multimedia support  ----
       Graphics support  --->
           <*> Support for frame buffer devices  --->
               <*> Si Image SII9022 DVI/HDMI Interface Chip
               <*> Freescale DCU framebuffer support
                   …
           [ ] Exynos Video driver support  ----
           [ ] Backlight & LCD device support  ----
               Console display driver support  --->
                   <*> Framebuffer Console support
                   [*] Map the console to the primary display device
                   [*] Framebuffer Console Rotation
           [*] Bootup logo  --->
               --- Bootup logo
               [*] Standard black and white Linux logo
               [*] Standard 16-color Linux logo
               [*] Standard 224-color Linux logo
   < > Sound card support  ----
```

Identifier

Below are the configure identifiers which are used in kernel source code and default configuration files.

Special Configure needs to be enabled ("Y") for LS1021A. Please find in below table with default value as "N"

Option	Values	Default Value	Description
CONFIG_ FB_FSL_SII902X	y/m/n	y	Si Image SII9022 DVI/HDMI Interface Chip
CONFIG_FB_FSL_DCU	y/m/n	y	Freescale DCU framebuffer supportt
CONFIG_LOGO	y/m/n	y	Bootup logo

Table continues on the next page...

Option	Values	Default Value	Description
CONFIG_LOGO_LINUX_MONO	y/m/n	y	Standard black and white Linux logo
CONFIG_LOGO_LINUX_VGA16	y/m/n	y	Standard 16-color Linux logo
CONFIG_LOGO_LINUX_CLUT224	y/m/n	y	Standard 224-color Linux logo
CONFIG_FRAMEBUFFER_CONSOLE	y/m/n	y	Framebuffer Console support

7.4.2.8 Device Tree Binding

Special Configure needs to be enabled ("Y") for LS1021A. Please find in below table with default value as "N"

arch/arm/boot/dts/ls1021a.dtsi

```
dcu0: dcu@2ce0000 {
            compatible = "fsl,vf610-dcu";
             reg = <0x0 0x2ce0000 0x0 0x10000>;
             interrupts = <GIC_SPI 172 IRQ_TYPE_LEVEL_HIGH>;
             clocks = <&platform_clk 0>;
             clock-names = "dcu";
             scfg-controller = <&scfg>;
              big-endian;
              status = "disabled";
};
```

arch/arm/boot/dts/ls1021a-twr.dts

```
&dcu0 {
        display = <&display>;
        status = "okay";

        display: display@0 {
                bits-per-pixel = <24>;

                display-timings {
                        native-mode = <&timing0>;
                        timing0: nl4827hc19 {
                                clock-frequency = <10870000>;
                                hactive = <480>;
                                vactive = <272>;
                                hback-porch = <2>;
                                hfront-porch = <2>;
                                vback-porch = <2>;
                                vfront-porch = <2>;
                                hsync-len = <41>;
                                vsync-len = <4>;
                                hsync-active = <1>;
                                vsync-active = <1>;
                        };
                };
        };
};
```

Ramdisk:

Please use the 'fsl-image-x11-ls1021a(XXXXX)rootfs.ext2.gz.gz' ramdisk from each release images, or you can just use the ramdisk image which has 'x11' label.

7.4.2.9 Source Files

The driver source is maintained in the Linux kernel source tree.

Source File	Description
drivers/video/fsl-dcu-fb.c	Freescale DCU driver

7.4.2.10 Testing LCD/DHMI at Uboot Level

1. Display with LCD:

```
=> setenv video-mode  "fslfb:480x272-32@60,monitor=twr_lcd"
=> save
=> reset
```

2. . Display with HDMI

```
=> setenv video-mode  "fslfb:640x480-32@60,monitor=hdmi"
=> save
=> reset
```

7.4.2.11 Testing LCD at Kernel Level

1. Configure and rebuild the kernel as configuration list above, let the DCU driver built into the Kernel Image.
2. Boot up Linux kernel, upon the kernel has been uncompressed, the TFT Panel will display the Linux Penguin Logo.
3. And then after the root filesystem has been monted, and the Xwindows Desktop will be display.
4. Or also you can start the Xwindow using:

```
root@ls1021atwr:~# killall matchbox-window-manager
root@ls1021atwr:~# xinit /etc/X11/Xsession
```

5. Just plug out and plug in the HDMI to test the hot plug.

7.4.2.12 Testing HDMI at Kernel Level

1. 1.Configure and rebuild the kernel as configuration list above, let the HDMI and DCU drivers built into the Kernel Image.
2. Boot up Linux kernel, upon the kernel has been uncompressed, the TFT Panel won’t display any picture correctly.

3. And then after the root filesystem has been monted, and the Xwindows Desktop will be displayed on the HDMI Monitor.
4. Or also you can start the Xwindow using:

```
root@ls1021atwr:~# killall matchbox-window-manager
root@ls1021atwr:~# xinit /etc/X11/Xsession

Note: Please unplugged the TWR-LDC_RGB daughter board when testing the
HDMI.
```

7.4.2.13 Benchmarking

N/A

7.4.2.14 Known Bugs, Limitations, or Technical Issues

1.Please unplug the SD card before testing the DCU/HDMI, or the system will hang.

7.4.2.15 Supporting Documentation

N/A

7.5 DMA Controller

7.5.1 Direct Memory Access Driver (PowerQUICC, QorIQ)

7.5.1.1 Description

Freescale Platform DMA Controller are integrated with the MPC85xx and QorIQ cpu.

7.5.1.2 Specifications

Target board:	Freescale MPC8xxx platform
CPU:	Freescale MPC8xxx processor, P4080, P2041, P3041,P3060,P5020
Software:	Linux 2.6.30 or later