DM&P X-Linux Developer's Manual

2005-06-20

DM&P X-Linux is a reduced Linux package for our user to test and use Linux easily on ICOP/DMP boards. Developer can start embedded development easily on X-Linux.

We offer free software support resource for your reference only. Our resource might lead you to other websites. It is to save your research time and we don't have any obligation or responsibility to provide further support or answer questions on your application. If you need any special assistance, please contact your account manager.

Update History

Release 5.3
- Linux kernel updated to 2.4.31.
- Use LILO 22.2 as boot loader.
- BusyBox updated.
- glibc updated to 2.3.2.
- Support USB mass storage and keyboard.
- Support Vortex86 audio.
- Support CD-ROM.
- Use tmpfs to replace RAM disk for /var and /tmp.
- Update web server to WN server 2.4.6.

Release 5.2 (2005-01-05)
- Linux kernel updated to 2.4.28.
- SysLinux updated.
- BusyBox updated.
- glibc updated to 2.3.2.
- Support USB mass storage and keyboard.
- Support Vortex86 audio.

Release 4 (2003-05-28)
- Linux kernel updated to 2.4.20.
- SysLinux updated.
- udhcp updated.
- BusyBox updated.
- PPP server function added.
- Login shell added.
- Set root filesystem to read only.
- Link /var and /tmp to RAM disk to reduce writing of disk.
- Serial console added. (Version 4.1 only)

Release 3 (2002-12-31)
- Loadable module support enabled.
- inetd added to take some of the effort out of running services such as telnet and ftp.
- TELNET service daemon added.
- WU-FTPD service daemon added.

Environment Overview

Software	Version	Path
Linux Kernel	2.4.31	/boot/linux
Boot Loader	LILO 22.2	/boot
Shell	BusyBox 1.00	/bin/busybox
FTP Server	WU-FTPD 2.6.2	/usr/sbin/ftpd
TELNET Server	netkit-telnet-0.17	/usr/sbin/telnetd
HTTP Server	WN Server 2.4.6	/usr/httpd
DHCP Client	udhcp Client 0.9.8	/usr/dhcpcd
Share Library	glibc 2.3.2	/lib
PPP Daemon	pppd 2.4.1	/sbin
Web Pages		/usr/www
Size Requirement		**< 6 MB**

Install X-Linux

We provide two solutions for programmer to restore X-Linux. If programmer has Notron GHOST, download GHOST file and use it to restore X-Linux. If programmer can not use GHOST to restore X-Linux, try to use tar.gz file:

1. Assume you have a Linux system and DOM is /dev/hdb in your system.
2. Use fdisk to make a primary Linux partition, as /dev/hdb1.
3. Format the partition as EXT2 file system.
4. Mount /dev/hdb1 to /mnt.
5. Change working directory to **/mnt** and run "`tar -xzvf ~/xlinuxr53.tar.gz`" to restore X-Linux file system.
6. Run "`ROOT=/mnt /mnt/sbin/lilo.real –C /etc/lilo.hdb.conf`" to install LILO.
7. umount /dev/hdb1.
8. Plug DOM to ICOP/DMP boards and set it as IDE master to boot.

Now, your DOM can boot into X-Linux.

Setup Files

File Name	Description
/boot/2.x.x.config	Linux kernel configuration file.
/boot/linux.img	Linux kernel.
/etc/fstab	This file makes it possible to automate the mounting of certain file systems, especially at system start-up.
/etc/ftpaccess	This file controls who gets into the FTP server and how.
/etc/hosts	A local database that associates the names of hosts with their IP addresses.
/etc/inetd.conf	This is the default configuration file for the inetd (super-server) daemon.
/etc/inetd.conf	The inetd.conf file contains the list of servers that inetd invokes when it receives an Internet request over a socket.
/etc/init.d/rcS	It will be run first and you can add your initial programs into it. We add statement assign our IP in this file.
/etc/inittab	This file plays a crucial role in the boot sequence.
/etc/lilo.conf	This file is used by lilo to determine which operating system or kernel to start, as well as to know where to install itself.
/etc/ppp/pap-secrets	User name and password file for PPP dial-up.
/etc/profile	It work as autoexec.bat under DOS and will be run automatically. We start inetd on /etc/profile.
/etc/securetty	This file allows you to specify which TTY devices the root user is allowed to login on.
/etc/services	This file contains information regarding the known services available in the DARPA Internet.
/usr/www	Our web pages are here.

Utilities

Run those commands via keyboard or scripts. List of important commands/scripts:

Command	Path	Description
ppp-on	/usr/sbin	Start a ppp connection.
ppp-off	/usr/sbin	Stop a ppp connection.
httpd	/sbin	Start a HTTP server.
dhcpcd	/sbin	Get IP address from DHCP server.
ifconfig	/sbin	Configure a network interface.
fsck.ext2	/sbin	Check and repair a Linux EXT2 file system.
fdisk	/sbin	Partition table manipulator for Linux.
mke2fs	/sbin	Create a Linux second extended file system.
setserial	/bin	Get/set Linux serial ports information.

TinyLogin commands: (refer to http://tinylogin.busybox.net/TinyLogin.html)

Path	Command
/bin	adduser, addgroup, deluser, delgroup, login, su
/sbin	sulogin
/usr/sbin	passwd

Commands listed below are implemented by BusyBox:

(You can go to http://www.busybox.net/downloads/BusyBox.html to get more information.)

Path	Command
/bin	ash, cat, chgrp, chmod, chown, cp, date, dd, df, dmesg, echo, egrep, false, fgrep, grep, gunzip, gzip, hostname, kill, ln, ls, mkdir, mknod, mktemp, more, mount, mv, pidof, ping, ps, pwd, rm, rmdir, sed, sh, sleep, sync, tar, touch, true, umount, uname, usleep, vi, zcat
/sbin	halt, ifconfig, init, klogd, pivot_root, poweroff, reboot, route, swapoff, swapon, syslogd, insmod, lsmod, rmmod
/usr/bin	[, basename, bunzip2, bzcat, chvt, clear, cmp, cut, deallocvt, dirname, du, env, expr, find, free, head, hexdump, id, install, killall, logger, openvt, readlink, reset, sort, strings, tail, tee, test, time, tr, tty, uniq, unzip, uptime, wc, wget, which, whoami, xargs, yes
/usr/sbin	chroot

Using X-Linux

Default setting may not meet programmer's requirement. Here are some sections to help developer to change X-Linux settings.

The default user name is **root** and password is **password**. Remember to change default password.

Enable Disk Writable

We only set root file system can be read because embedded system will power-off at any time. If any data want to save into disk, re-mount disk writable is needed. For example: user wants to use FTP to upload file, he should uses telnet to X-Linux and do those steps:

```
# mount -o remount,rw / (mount root filesystem readable/writable)
# (use FTP to upload files...)
# sync (flush filesystem buffers)
# mount -o remount,ro / (mount root filesystem read only)
```

Set Fixed IP Address

If user wants to use fixed IP address, change this line in /etc/init.d/rcS:

```
echo X-Linux: Set IP=192.168.0.222
ifconfig eth0 192.168.0.222
```

Using DHCP

Remove the "#" in /etc/init.d/rcS to enable DHCP:

```
# echo X-Linux: Get IP from DHCP server
# dhcpcd
```

Use PPP Dial-Up

Modify configuration files with information from your ISP to enable PPP dial-up. We recommend using FTP to download it, modify it, then, and upload it. Assume you connect modem to COM1.

1.   **/etc/ppp/pap-secrets**

This file contain user's account, you can see first line:

```
my_username  ppp0  my_password
```

"my_username" is your dial-up account user name, "my_password" is password. You should change them with yours.

2. **/usr/sbin/ppp-on**

```
#!/bin/sh
pppd nodetach lock modem crtscts /dev/ttyS0 38400 noipdefault defaultroute noauth \
name my_username connect "chat -v '' ATDT123456789 CONNECT" &
```

You should replace "my_username" with your user name as "/etc/ppp/pap-secrets". \ "ATDT123456789" is AT command to dial to ISP. You should replace "123456789" with your ISP's phone number.

Now, you can type "ppp-on" to dial-up to your ISP and "ppp-off" to hang-up. Type "ifconfig" to display network configuration, you can find device "eth0" and "ppp0". Any problem, mail us to help you to dial-up.

Enable PPP Server

Follow those steps to enable PPP server function.

1. **/etc/inittab**

You can find those two lines on /etc/inittab:

```
# remove '#' of next line to enable PPP server function, but ppp client function will
not work
#ttyS0::respawn:/sbin/mgetty -D -a modem ttyS0
```

Remember to remount root filesystem readable/writable and remove '#' of "#ttyS0".

2. **/etc/ppp/options.ttyS0**

Use mv to restore /etc/ppp/options.ttyS0:

```
# mv /etc/ppp/options.ttyS0.pppd /etc/ppp/options.ttyS0
```

/etc/ppp/options.ttyS0 is needed for PPP server.

3. **PPP Account**

Default use name and password for PPP client to dial-up are "pppuser" and "xlinux". If you want to add other user account, just duplicate line 2 of "/etc/ppp/pap-secrets" and replace "pppuser" with new user name and "xlinux" with new password:

```
my_username  ppp0  my_password *
pppuser      *     xlinux     *
```

After doing that, login in as root and do those steps:

```
# adduser new_user_name (add new user)
# passwd new_user_name  (change user's password)
```

Because accepting PPP dial-up will run mgetty which read account data from system to verify user, we have to add

user account to accord with /etc/ppp/pap-secrets.

4.   Run "sync" command and reboot xLinux.

If you enable PPP server function, PPP client dial-up function of xLinux will not work.

Enable Serial Console

Flow those steps to add serial console into X-Linux R5:

1.   Run **"mount -o remount,rw /"** to make root file system can be read/wrote.
2.   Edit **/etc/inittab** to add this line

```
::respawn:/sbin/getty –L ttyS0 9600
```

3.   Edit **/etc/securtty** to add those lines:

```
ttyS0
ttyS1
```

4.   Edit **/etc/lilo.conf** to add this line:

```
APPEND="console=tty1 console=ttyS0,9600n8"
```

5.   Run "**lilo.real**" to write lilo.conf into boot loader.
6.   Run "sync" and reboot the device.
7.   Use a cross RS-232 cable to connect to X-Linux and your PC.
8.   Run terminal program and set COM parameters:

```
Baud Rate   = 9600
Parity Bit  = No
Data Bits   = 8
Stop Bits   = 1
Flow Control = OFF
```

9.   Turn on X-Linux device. You can get message from serial port and login now.

When /dev/ttyS0 is used by serial console, PPP client or server function will not work. You can enable one of them or use another serial port (ex: /dev/ttyS1) for serial console or PPP.

Use USB Mass Storage

USB function is enabled in X-Linux kernel. After enabling USB in BIOS, X-Linux can find USB mass storeage device. When USB storage is plugged, Linux will find SCSI devices:

```
hub.c: new USB device 00:01.2-1, assigned address 2
scsi0 : SCSI emulation for USB Mass Storage devices
  Vendor: Usb      Model: Flash Disk      Rev: 1.11
  Type:   Direct-Access                   ANSI SCSI revision: 02
```

```
 Attached scsi removable disk sda at scsi0, channel 0, id 0, lun 0
 SCSI device sda: 129024 512-byte hdwr sectors (66 MB)
 sda: Write Protect is off
  sda: sda1 sda2 < >
```

Mount USB storage:
```
~ # mount /dev/sda1 /mnt
```

Now, you can read/write USB storage. Linux kernel in X-Linux only support EXT2 and FAT16/32 file system. If you other file system on USB storage, X-Linux can not recognize it. Beside, before removing your USB storage, please unmount USB device first. Also, USB keyboard can work with X-Linux.

Install Vortex86 Audio Driver

To install Vortex86 audio driver, run those:
```
~ # modprobe sis7019
```
You can add it into /etc/profile to automatically install.

Enable CD-ROM Access

Here are the steps to access CD-ROM:
```
~ # modprobe isofs
~ # modprobe ide-cd
~ # mount /dev/hdb /mnt
```
Those commands will load ISO9660 file system module and mount CD-ROM.

Boot from USB Mass Storage

Some people install X-Linux onto USB mass storage and X-Linux will hang while booting. In order to boot from USB mass storage, use those codes to replace old function in file /init/do_mounts.c of kernel 2.4.x source files:
```
static void __init mount_block_root(char *name, int flags)
{
    char *fs_names = __getname();
    char *p;

    get_fs_names(fs_names);
retry:
    for (p = fs_names; *p; p += strlen(p)+1) {
        int err = sys_mount(name, "/root", p, flags, root_mount_data);
        switch (err) {
            case 0:
```

```
                goto out;
            case -EACCES:
                flags |= MS_RDONLY;
                goto retry;
            case -EINVAL:
                case -EBUSY:
                continue;
        }
            /*
         * Allow the user to distinguish between failed open
         * and bad superblock on root device.
         */
        printk ("VFS: Cannot open root device \"%s\" or %s\n,
            retrying in 1 second.",root_device_name, kdevname (ROOT_DEV));
        printk ("You may need to append a correct \"root=\" boot option");
        printk ("or wait for the root device to become ready.");

        /* wait 1 second and try again,
         * allowing time for hubs/devices to become ready */
        set_current_state(TASK_INTERRUPTIBLE);
        schedule_timeout(HZ);
        goto retry;
    }
    panic("VFS: Unable to mount root fs on %s", kdevname(ROOT_DEV));
out:
    putname(fs_names);
    sys_chdir("/root");
    ROOT_DEV = current->fs->pwdmnt->mnt_sb->s_dev;
    printk("VFS: Mounted root (%s filesystem)%s.\n",
        current->fs->pwdmnt->mnt_sb->s_type->name,
        (current->fs->pwdmnt->mnt_sb->s_flags & MS_RDONLY) ? " readonly" : "");
}
```

Make Your Linux Kernel

If developer wants to extend Linux kernel function, copy the kernel configuration file from X-Linux (for example, the /boot/2.4.31.config is kernel configuration for Linux kernel 2.4.31) to your Linux kernel source code directory and rename it to "**.config**". Then, you can make your kernel based on X-Linux kernel.

Install Your Program

This is an example form our Mity-Mite demo box Linux version. We wrote simple LCM library under Linux.

FTP server is enabled on our Linux DOC/MDM that can use FTP to upload programs. The default user name is "root" and password is "password". Install Linux (Red Hat, Mandrake, SuSE...) on a powerful PC to develop applications is recommended. Write and compile programs then upload it to Mity-Mite/Tiny module via FTP to test. Kill the process if program is not correct. Repeat those steps until programs are okay. There is an example:

1.   We create a directory "/demo".
2.   Put lcd (LCD driver), dmp.bmp (DM&P logo, will loaded by lcd) and lcd_time (send time to display every 0.5 second) into "/demo".
3.   Write a script "demo" to load lcd and lcd_time.
```
#!/bin/sh./lcd&
sleep 5
./lcd_time&
```
4.   Remember to change mode of upload files to executable.
```
chmod +x ./lcd
chmod +x ./lcd_time
chmod +x ./demo
```
5.   Run "demo" to test. If programs are not correct, use "ps" to find process ID of program to kill it. Go to step 2 until programs are okay.
```
# ps
  PID  Uid     Stat Command
    1 0         S    init
    2 0         S    [keventd]
    3 0         S    [ksoftirqd_CPU0]
    4 0         S    [kswapd]
    5 0         S    [bdflush]
    6 0         S    [kupdated]
   11 0         S    -sh
   14 0         S    ./ftpd
   17 0         S    /usr/httpd/wnsd -p 80
   19 0         S    ./lcd
   21 0         S    ./lcd_time
   22 0         R    ps
# kill 21
# kill 22
```

Also, you can lunch "demo" script at /etc/profile to run it automatically when program is okay.

Hint

Before uploading your programs, use "ldd" to check share library dependency. Upload share library to /lib first if need.

```
[root@/root/grlcd]# ldd lcd
      libstdc++-libc6.2-2.so.3      =>      /usr/lib/libstdc++-libc6.2-2.so.3
(0x4002c000)
      libm.so.6 => /lib/libm.so.6 (0x4006e000)
      libc.so.6 =>  /lib/libc.so.6 (0x40090000)
      /lib/ld-linux.so.2 =>  /lib/ld-linux.so.2 (0x40000000)
[root@/root/grlcd]#
```

Reference Links

Linux Kernel	http://www.kernel.org/
SysLinux	http://syslinux.zytor.com/
BusyBox	http://www.busybox.net/
TinyLogin	http://tinylogin.busybox.net/
Linux NetKit	ftp://ftp.uk.linux.org/pub/linux/Networking
WU-FTPD	http://www.wu-ftpd.org/
WN Server	http://hopf.math.nwu.edu/
Udhcp	http://udhcp.busybox.net/
LILO	http://en.wikipedia.org/wiki/LILO_(boot_loader)

Technical Support

For more technical support, please visit http://www.dmp.com.tw/tech or mail to tech@dmp.com.tw.