
INSTALLATIONGUIDE

DSP/BIOS™ LINK**DM357****LNK 201 USR****1.65.00.03****JUL 12, 2010**

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A. INTRODUCTION



1 Purpose

DSP/BIOS™ LINK is foundation software for the inter-processor communication across the GPP-DSP boundary. It provides a generic API that abstracts the characteristics of the physical link connecting GPP and DSP from the applications. It eliminates the need for customers to develop such link from scratch and allows them to focus more on application development.

This document provides the users necessary information to install DSP/BIOS™ LINK on the development host.

This document corresponds to the product release 1.65.00.03 dated JUL 12, 2010.

2 TextConventions

	This bullet indicates important information. Please read such text carefully.
	This bullet indicates additional information.
[arg1 arg2]	In context of the commands, contents enclosed in square brackets are the optional arguments to the command. Different values of these arguments are separated by " ".

3 Terms&Abbreviations

CCS	Code Composer Studio
IPC	Inter Processor Communication
GPP	General Purpose Processor e.g. ARM
DSP	Digital Signal Processor e.g. TMS320DM357
CGTools	Code Gen Tools, e.g. Compiler, Linker, Archiver

4 References


1.	Montavista Linux InstallGuide-Pro50_highres.pdf Professional Edition 5.0 - Installation Guide
2.	REL_LSP_02_00_00_1 Release notes and User Guide. 40.gz


B. INSTALLATION


5 BasicInstallation

The DSP/BIOS™ LINK is made available as a tar.gz file. To install the product follow the steps below:

1. Unzip and untar the file dsplink_1.65.00.03.tar.gz.

 *This document assumes the install path to be in the user home directory if working on a Linux PC. This path will be used in remainder of this document.*

 *This document assumes the install path to be `L:\dsplink` if working on a Windows PC. This path will be used in remainder of this document.*

 *If the installation was done at different location, make appropriate changes to the commands listed in the document.*

It is advisable to archive the released sources in a configuration management system. This will help in merging:

- The updates delivered in the newer releases of DSP/BIOS™ LINK.
- The changes to the product, if any, done by the users.

5.1 Installing Standalone DSP/BIOS™ and CGTools

For compilation of DSP-side sources and applications for DM357, the CGTools version 6.0.18 can be used. This release has been validated with DSP/BIOS™ version 5.33.03.

This release will not work with BIOS version earlier than 5.32.01.

The standalone DSP/BIOS™ and standalone CGTools are available for Linux platform as well. Refer to the URL mentioned below for getting the distribution of DSP/BIOS™ and the associated installation instructions.

https://www-a.ti.com/downloads/sds_support/targetcontent/bios/index.html

The directory structure specified in Figure 1 is expected by the build system of DSP/BIOS™ LINK. If you install the tools to a different directory, you will also need to modify the make system and the scripts contained in the release package. You may need to copy the directories to create the structure expected for compiling sources. Refer to section on "Understanding The MAKE System" in the User Guide for details.

5.2 Installing GNU make 3.81

For compilation of DSPLINK sources the GNU make 3.81 can be used. Download the make 3.81 from the URL

<http://ftp.gnu.org/pub/gnu/make/make-3.81.tar.gz>

The following are the installation steps required to install make on the development host machine.

1. Copy and untar make-3.81.tar.gz to your home directory.

2. cd to make-3.81 directory
3. Type './configure' and press enter to configure the package for your system. Running `configure' takes awhile. By default, make package's files will be installed in `/usr/local/bin', `/usr/local/man', etc.

You can specify an installation prefix other than `/usr/local' by giving `configure' the option `-- prefix=PREFIX'.

For example,

To install make at /usr/local/bin
run the configure command like below.
./configure --prefix=/usr/local.

To install make at /usr/bin
run the configure command like below.
./configure --prefix=/usr

4. Type `make' and press enter to compile the package.
5. Optionally, type `./make check' and press enter to run any self-tests that come with the package.
6. Type `make install' and press enter to install the programs and any data files and documentation.
7. *For additional details refer to INSTALL file located under make-3.81 directory.*

6 Creating development workspace

This document and the scripts included in the release assume the following directory structure on your development host:

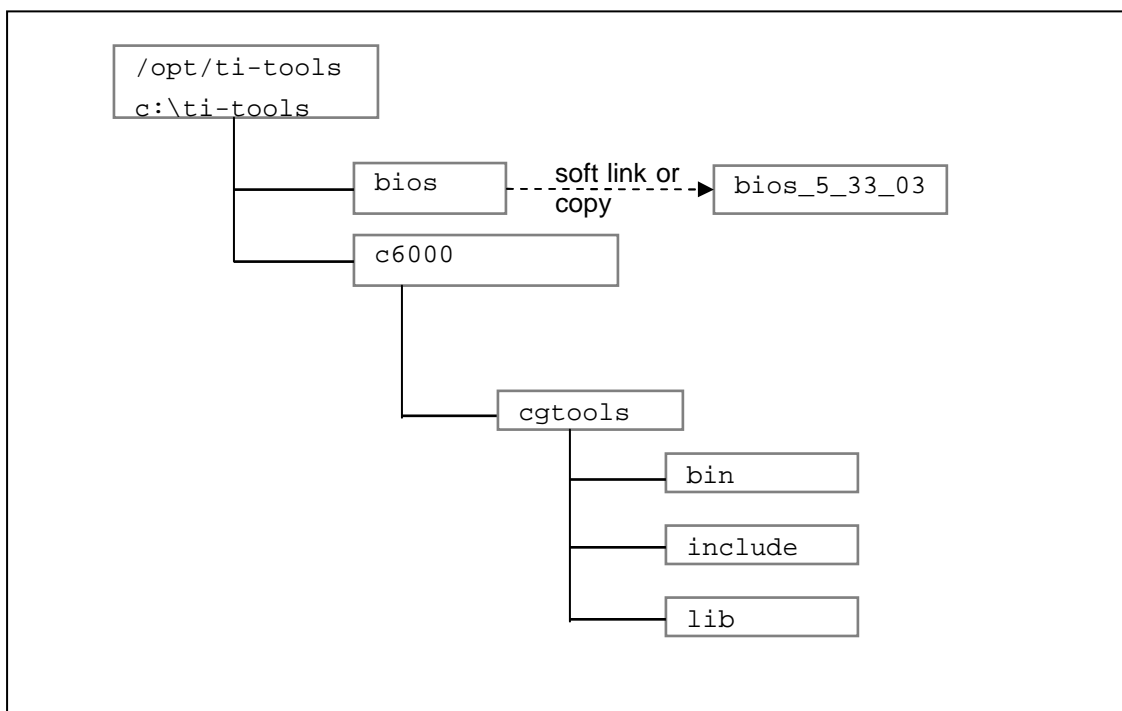


Figure1. Expected directory structure on development host


- For Linux, the build system shipped with DSP/BIOS™ LINK assumes that the standalone DSP/BIOS™ is installed in the /opt/ti-tools/ directory on the <ROOT-DRIVE> and CGTools is installed in the 'ti-tools/c6000' directory on the <ROOT-DRIVE>.
- For the Windows development host, the build system shipped with DSP/BIOS™ LINK assumes that the standalone DSP/BIOS™ is installed in the 'ti-tools\' directory on the <ROOT-DRIVE> and CGTools is installed in the 'ti-tools\c6000\' directory on the <ROOT-DRIVE>.
- To support multiple installations of DSP/BIOS with a single DSP/BIOS™ LINK DSP-side distribution file, a standard /opt/ti-tools/bios on Linux and c:\ti-tools\bios directory is used for the BIOS installation. This can be a soft link or copy to the actual DSP/BIOS installation directory.


7 Setting up Linux Workstation for Montavista pro 5.0

7.1 Setting up workstation for Montavista pro 5.0 – uclibc

The description in this section is based on the following assumptions:

1. Host PC with RedHat Enterprise Linux version 9.0 to install the MVL uclibc package.
2. Services telnetd, nfsd, ftpd are configured on this workstation.
3. The workstation is assigned a fixed IP address.
4. 3GB Space is required for the installation of tool chain for a single LSP of a single architecture type.

 *The release package has been tested on RedHat Linux version 9.0. You may be able to build on a different version depending on the compatibility of the build tools in your version with version 9.0.*

 *A fixed IP address is preferred, as the IP address needs to be specified while booting the target board. This allows the boot loader configuration to be saved in flash.*

This document and the scripts included in the release assume the following directory structure in your home directory on the Linux workstation:

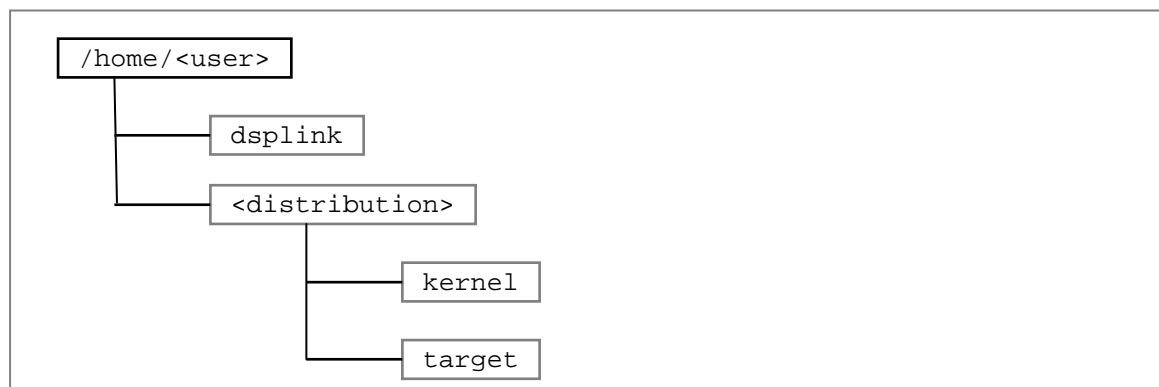


Figure2. Expected directory structure on the Linux workstation for MVL pro 5.0 – uclibc

In this diagram:

- *<user>* represents the actual user name
- *<distribution>* represents the actual distribution of Linux being used.

This section assumes that Montavista Linux Professional Edition 5.0 is installed on the development workstation at `/opt/montavista/pro`.

7.1.1 Building the kernel

These steps are for the Linux PSP package for DM357.

Please refer to the release notes for Linux LSP package for detailed build steps.

1. Download the required Montavista packages from Montavista website:

pro-host-arm_v5t_le-0702774.iso

```
lsp-arm_v5t_le_uclibc-0702774.iso
devrocket-0702794.iso
src-pro-0702774.iso
docs-pro-0702774.iso
```

2. Step a: Transfer these images/isos to the Host machine.
Step b: Create few mount points to mount the isos.
For minimum installation, i.e. without docs, only two mount points are required.

Step c: Mount the following isos.

- pro-host-arm_v5t_le-0702774.iso
- lsp-arm_v5t_le_uclibc-0702774.iso

If in your system /dev/loop0 or /dev/loop1 is already used up then you can try using /dev/loop2.....n onwards.

Step d: On a new console (as root) run the command to start the web server to install the tool chain.

Step e: On another console run (as root) the command to install the tool chain.

Please follow the on screen steps and complete the installation. Please note that installation selection is on LSP basis.

Step b : Directory creation example

```
$mkdir /mnt/iso1
      $mkdir /mnt/iso2
```

Step c: Mount command example:


```
$mount -t iso9660 pro-host-arm_v5t_le-0702774.iso /mnt/iso1 -o
loop=/dev/loop0

$mount -t iso9660 lsp-arm_v5t_le_uclibc-0702774.iso /mnt/iso2 -o
loop=/dev/loop1
```

Step d: \$/mnt/iso1/install --host Redhat

Step e: \$/tmp/mvl-install/bin/links http://127.0.0.1:9999/mvlinstaller.cgi
or

From a windows machine open a web browser and run http://<ip-address of linux pc>:9999

 *The sources can be copied to a different location. In such a case ~/montavista/kernel/Linux can be a soft link to the actual location.*

3. Get the required DM357 LSP package from https://www-a.ti.com/downloads/sds_support/targetcontent/psp/index.html. Copy the kernel sources to your workspace:

```
~/montavista/kernel/Linux
```

4. Modify your search path to include kernel build tools.

```
$ set path = (/opt/montavista/pro/devkit/arm/v5t_le/bin $path)
```

```
$ set path = (/opt/montavista/pro/bin $path)
```

- ❑ *You can modify the shell startup file to include the paths in the standard search path.*

5. Configure the kernel for the DM357 platform.

Ensure that the kernel is configured for DM357. Further, DHCP should be enabled.

Also ensure that you disable the CONFIG_PREEMPT option if it is already selected and ensure that EABI option is selected.

DSP/BIOS Link supports the following pre-emption mode

- No Forced Preemption (Server)
- Voluntary Kernel Preemption (Desktop)
- Preemptible kernel (Low Latency Desktop)

DSP/BIOS Link does not support Complete Preemption (Real-Time)

DM357:-

```
$make ARCH=arm CROSS_COMPILE=arm_v5t_le_uclibc-  
davinci_dm357_defconfig
```

```
$make ARCH=arm CROSS_COMPILE=arm_v5t_le_uclibc- menuconfig
```

6. Build the kernel.

```
$make ARCH=arm CROSS_COMPILE=arm_v5t_le_uclibc- uImage
```

The image for compressed kernel – uImage – is generated after successful completion of the build process in the arch/arm/boot directory.

7.1.2 EnableTFTPfordownloadingthekernelimage totarget

U-boot can be configured to download the kernel onto the target by various mechanisms:

- a. TFTP
- b. Serial Port

This section configures the Linux development host as a TFTP server.


Modify the 'xinet.d/tftp' file to enable TFTP:

1. Make the following changes:

```
disable      = no  
server_args = -s /tftpboot
```

2. Restart the network service

```
$ /etc/init.d/xinetd restart
```

 *The above configuration assumes that a directory 'tftpboot' has been created at the root '/' directory. The files in this directory are exposed through the TFTP protocol.*

7.1.3 Createtargetfilesystem


The target device needs a file system to boot from. The file system can either be exported to the target through NFS, or a RAMDISK can be used.


7.1.4 ExportingtargetfilesystemthroughNFS


A directory on the development host can be setup and exported for this purpose.

1. Copy the target file system to your workspace.

```
$ cp -a /opt/montavista/pro/devkit/arm/v5t_le/target
~/montavista/target
```

 *Enter the command shown above in a single line.*


 *You need to be 'root' to successfully execute this command.*

 *The file system can be copied to a different location. In such a case ~/montavista/target can be a soft link to the actual location.*

3. The directory ~/montavista/target will be mounted as root directory on the target through NFS.

To do so, add the following line to the file /etc/exports.


```
/home/<user>/montavista/target *(rw,no_root_squash)
```

 *Replace "/home/<user>" in the path above with the actual path of your home directory on the development workstation.*

7.2 SettingupworkstationforMontavistapro5.0– glibc

The description in this section is based on the following assumptions:

1. Host PC with RedHat Linux 9 to install the MVL glibc package.
Installation using the iso's released by Montavista fail on host pc with RedHat Enterprise Linux workstation 3 or 4.
2. Services telnetd, nfsd, ftpd are configured on this workstation.
3. The workstation is assigned a fixed IP address.
4. 4GB Space is required for the installation of tool chain for a single LSP of a single architecture type.

 *A fixed IP address is preferred, as the IP address needs to be specified while booting the target board. This allows the boot loader configuration to be saved in flash.*

This document and the scripts included in the release assume the following directory structure in your home directory on the Linux workstation:

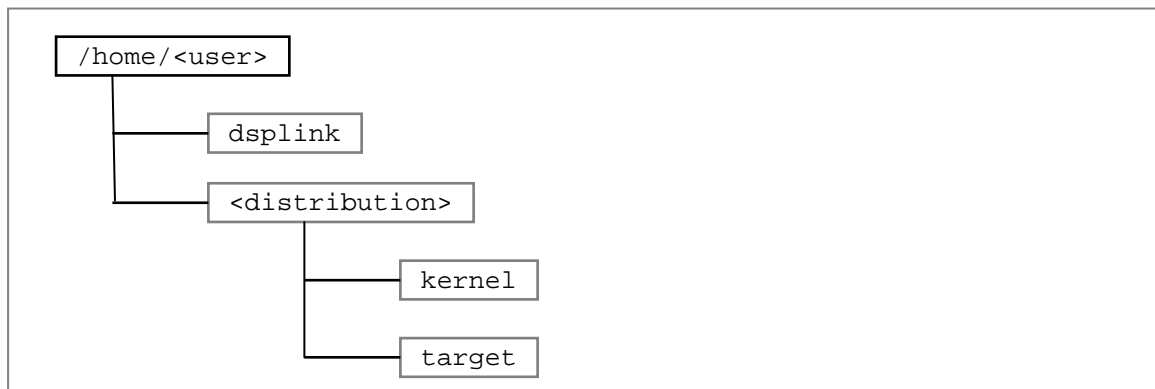


Figure3. Expected directory structure on the Linux workstation for MVL pro 5.0 – glibc

In this diagram:

- *<user>* represents the actual user name
- *<distribution>* represents the actual distribution of Linux being used.

This section assumes that Montavista Linux Professional Edition 5.0 is installed on the development workstation at `/opt/montavista/pro`.

7.2.1 Building the kernel

These steps are for the Linux PSP package for DM357.

Please refer to the release notes for Linux LSP package for detailed build steps.

1. Download the required Montavista packages from Montavista website:

```

pro-host-arm_v5t_le-0702774.iso
lsps-arm_v5t_le-0702774.iso
devrocket-0702794.iso
src-pro-0702774.iso
docs-pro-0702774.iso
  
```

2.
 - Step a: Transfer these images/isos to the Host machine.
 - Step b: Create few mount points to mount the isos.
For minimum installation, i.e. without docs, only two mount points are required.
 - Step c: Mount the following isos.
 - pro-host-arm_v5t_le-0702774.iso
 - lsps-arm_v5t_le_0702774.iso
 If in your system `/dev/loop0` or `/dev/loop1` is already used up then you can try using `/dev/loop2.....n` onwards.
 - Step d: On a new console (as root) run the command to start the web server to install the tool chain.
 - Step e: On another console run (as root) the command to install the tool chain.

Please follow the on screen steps and complete the installation. Please note that installation selection is on LSP basis.

Step b : Directory creation example

```
$mkdir /mnt/iso1
```

```
$mkdir /mnt/iso2
```


Step c: Mount command example:

```
$mount -t iso9660 pro-host-arm_v5t_le-0702774.iso /mnt/iso1 -o  
loop=/dev/loop0
```

```
$mount -t iso9660 lsps-arm_v5t_le-0702774.iso /mnt/iso2 -o  
loop=/dev/loop1
```

Step d: `$/mnt/iso1/install --host Redhat`

Step e: `$/tmp/mvl-install/bin/links http://127.0.0.1:9999/mvlinstaller.cgi`

 *The sources can be copied to a different location. In such a case `~/montavista/kernel/Linux` can be a soft link to the actual location.*


3. Get the required DM357 LSP package from https://www-a.ti.com/downloads/sds_support/targetcontent/psp/index.html. Copy the kernel sources to your workspace:

```
~/montavista/kernel/Linux
```

4. Modify your search path to include kernel build tools.

```
$ set path = (/opt/montavista/pro/devkit/arm/v5t_le/bin $path)
```

```
$ set path = (/opt/montavista/pro/bin $path)
```

 *You can modify the shell startup file to include the paths in the standard search path.*

5. Configure the kernel for the DM357 platform.

Ensure that the kernel is configured for DM357. Further, DHCP should be enabled.

Also ensure that you disable the CONFIG_PREEMPT option if it is already selected and ensure that EABI option is selected.

DSP/BIOS Link supports the following pre-emption mode

- No Forced Preemption (Server)
- Voluntary Kernel Preemption (Desktop)
- Preemptible kernel (Low Latency Desktop)

DSP/BIOS Link does not support Complete Preemption (Real-Time)

DM357:-

```
$make ARCH=arm CROSS_COMPILE=arm_v5t_le- davinci_dm357_defconfig
```

```
$make ARCH=arm CROSS_COMPILE=arm_v5t_le- menuconfig
```

6. Build the kernel.


```
$make ARCH=arm CROSS_COMPILE=arm_v5t_le- uImage
```

The image for compressed kernel – uImage – is generated after successful completion of the build process in the arch/arm/boot directory.

7.2.2 EnableTFTPfordownloadingthekernelimage totarget

U-boot can be configured to download the kernel onto the target by various mechanisms:

- a. TFTP
- b. Serial Port

This section configures the Linux development host as a TFTP server.


Modify the 'xinet.d/tftp' file to enable TFTP:

1. Make the following changes:

```
disable      = no
server_args  = -s /tftpboot
```

2. Restart the network service

```
$ /etc/init.d/xinetd restart
```

 *The above configuration assumes that a directory 'tftpboot' has been created at the root '/' directory. The files in this directory are exposed through the TFTP protocol.*

7.2.3 Createtargetfilesystem


The target device needs a file system to boot from. The file system can either be exported to the target through NFS, or a RAMDISK can be used.

7.2.4 ExportingtargetfilesystemthroughNFS


A directory on the development host can be setup and exported for this purpose.

1. Copy the target file system to your workspace.

```
$ cp -a /opt/montavista/pro/devkit/arm/v5t_le/target
~/montavista/target
```

 *Enter the command shown above in a single line.*


 *You need to be 'root' to successfully execute this command.*

 *The file system can be copied to a different location. In such a case ~/montavista/target can be a soft link to the actual location.*

3. The directory ~/montavista/target will be mounted as root directory on the target through NFS.

To do so, add the following line to the file /etc/exports.

```
/home/<user>/montavista/target *(rw,no_root_squash)
```

 *Replace "/home/<user>" in the path above with the actual path of your home directory on the development workstation.*

8 Configuring CCS

8.1 DM357EVM

To use CCS for debugging the DSP side application, you will need to configure CCS to use both ARM and DSP with the DM357 EVM. The EVM must be configured to use the DSP self-boot mode.

- ❑ *CCS can attach to only ARM in the beginning. It can attach to the DSP only after the ARM-side application releases it from reset through a call to `PROC_Start ()`.*

C. WORKING ON TARGET PLATFORM

9 DM357EVM

9.1 SettingupLinuxenvironment

Refer to the PSP Linux release/install guide document for instructions on setting up the Linux execution environment for the DM357 EVM.

```
REL_LSP_02_00_00_140/PSP_02_00_00_140/docs/
```

9.2 U-Bootboot-loader

Please refer the PSP Linux release/install to load the u-boot.bin to the target. REL_LSP_02_00_00_140 contains images for the Boot Loader, NFS File system.

```
REL_LSP_02_00_00_140/PSP_02_00_00_140/bin/dm357
```

```
REL_LSP_02_00_00_140/PSP_02_00_00_140/docs/
```

9.3 ConfiguringKernelParameters

DSP/BIOS™ LINK requires a few specific arguments to be passed to the Linux kernel during boot up. 2MB of memory is used by DSP/BIOS™ LINK for communication between GPP and DSP, and for DSP external memory. This must be reserved by specifying 2MB less as available for the Linux kernel for its usage.

- ☐ *Initial 16MB is reserved for DSP, So need to set the mem=240M in the bootargs*

9.4 ConfiguretheDSP/BIOSLINKforDM357

The build configuration command must be executed to configure DSPLink for the various parameters such as platform, GPP OS, build configuration etc.

DM357 (Pro 5 uclibc)

```
perl dsplinkcfg.pl --platform=DM357 --nodsp=1 --dspcfg_0=DM357GEMSHMEM --  
dspos_0=DSPBIOS5XX --gppos=MVL5U --comps=ponslrnc
```

DM357 (Pro 5 glibc)

```
perl dsplinkcfg.pl --platform=DM357 --nodsp=1 --dspcfg_0=DM357GEMSHMEM --  
dspos_0=DSPBIOS5XX --gppos=MVL5G --comps=ponslrnc
```

- ☐ *For details please refer user guide.*

9.5 BuildingDSPLink

Please refer to User Guide for generic instructions on configuring and building DSPLink.

10 Runningthesampleapplications

Seven sample applications are provided with DSPLINK for the DM357 platform. All the sample applications are described in detail in the user guide. This section describes the way to execute the sample applications.

The specific instructions shown below refer to the message sample. However, similar instructions can be used for the other applications also.

The steps for execution of the samples are given below for execution with Linux running on the GPP.

The steps for execution of the samples are given below with DM357 variant of the DM357 platform. Similar instructions can be used for the DM6467 variant also.

10.1 Copyingfilestotargetfilesystem

The generated binaries on the GPP side and DSP side and the data files must be copied to the target directory. The commands below demonstrate this for the 'message' sample application as reference. Appropriate sample directory name must be used for other sample applications.


GPP Side


For executing the DEBUG build, follow the steps below to copy the relevant binaries:

```
$ cd ~/dsplink
$ cp gpp/export/BIN/Linux/DM357/DEBUG/messagegpp
~/montavista/target/opt/dsplink/samples/message
$ cp gpp/export/BIN/Linux/DM357/DEBUG/dsplinkk.ko
~/montavista/target/opt/dsplink/
```

For executing the RELEASE build, follow the steps below to copy the relevant binaries:

```
$ cd ~/dsplink
$ cp gpp/export/BIN/Linux/DM357/RELEASE/messagegpp
~/montavista/target/opt/dsplink/samples/message
$ cp gpp/export/BIN/Linux/DM357/RELEASE/dsplinkk.ko
~/montavista/target/opt/dsplink/
```

 *Enter the commands shown above in single line.*

 *By default Ring_IO sample runs in multithread mode. To run the sample in multi process mode, define RINGIO_MULTI_PROCESS flag in \$DSPLINK\gpp\src\samples\ring_io\Linux\COMPONENT file and build the sample.*

DSP Side

The DSP binaries can be built either on the Linux workstation or the Windows host.

After the binaries have been built, they must be copied into the target file system. If the binaries are generated on Windows PC, any FTP client can be used for transferring these to the target file system.

For executing the DEBUG build:

1. Copy the following file into the directory

```
~/montavista/target/opt/dsplink/samples/message:
dsplink/dsp/export/BIN/DspBios/DM357/DM357GEM_x/DEBUG/message.out
```

For executing the RELEASE build:

1. Copy the following file into the directory
~/montavista/target/opt/dsplink/samples/message:
dsplink/dsp/export/BIN/DspBios/DM357/DM357GEM_x/RELEASE/message.out

10.2 Loading the kernel module: dsplinkk.ko

To load the device driver, login as 'root' and enter following commands on the command prompt.

```
$ cd /opt/dsplink
$ insmod dsplinkk.ko
$ mknod /dev/dsplink c 230 0
```

This action generates a warning indicating that the kernel module does not contain the GPL license. This warning can be safely ignored.

10.3 Invoking the application

10.3.1 Loopsample

To invoke the application enter the following commands:

```
$ cd /opt/dsplink/samples/loop
$ ./loopgpp loop.out <buffer size> <iterations> < DSP Processor Id >
```

☐ *The sample can be executed for infinite iterations by specifying the number of iterations as 0.*

☐ *The DSP Processor Id is optional. By default it is zero.*

e.g.

```
$ ./loopgpp loop.out 1024 10000
```

10.3.2 Messagesample

```
$ cd /opt/dsplink/samples/message
$ ./messagegpp message.out <number of iterations> < DSP Processor Id >
```

☐ *The sample can be executed for infinite iterations by specifying the number of iterations as 0.*

☐ *The DSP Processor Id is optional. By default it is zero.*

e.g.

```
$ ./messagegpp message.out 10000
```

10.3.3 Scalesample

```
$ cd /opt/dsplink/samples/scale
$ ./scalegpp scale.out <buffer size> <iterations> < DSP Processor Id >
```

- ☐ *The sample can be executed for infinite iterations by specifying the number of iterations as 0.*

- ☐ *The DSP Processor Id is optional. By default it is zero.*

e.g.

```
$ ./scalegpp scale.out 1024 10000
```

10.3.4 Ring_IOSample

```
$ cd /opt/dsplink/samples/ring_io
$ ./ringiogpp ringio.out <RingIO data buffer size in bytes> < number of
Bytes to transfer> < DSP Processor Id >
```

- ☐ *The sample can be executed for infinite iterations by specifying the number of Bytes to transfer as 0.*

- ☐ *The DSP Processor Id is optional. By default it is zero.*

e.g.

```
$ ./ringiogpp ringio.out 1024 10240
```

10.3.5 Readwritesample

```
$ cd /opt/dsplink/samples/readwrite
$ ./readwritegpp readwrite.out <DSP address> <buffer size> <iterations>
< DSP Processor Id >
```

- ☐ *The sample can be executed for infinite iterations by specifying the number of iterations as 0.*

- ☐ *The DSP Processor Id is optional. By default it is zero.*

e.g.

```
$ ./readwritegpp readwrite.out 2148466688 1024 10000
$ ./readwritegpp readwrite.out 293601280 1024 10000
$ ./readwritegpp readwrite.out 300957696 1024 10000
```

10.3.6 MPCSXFERsample

```
$ cd /opt/dsplink/samples/mpcsxfer
$ ./mpcsxfergpp mpcsxfer.out <buffer size> <iterations> < DSP Processor
Id >
```

- ☐ *The sample can be executed for infinite iterations by specifying the number of iterations as 0*

- ☐ *The DSP Processor Id is optional. By default it is zero.*

e.g.

```
$ ./mpcsxfergpp mpcsxfer.out 1024 10000
```

10.3.7 MP_LISTsample

```
$ cd /opt/dsplink/samples/mp_list
$ ./mplistgpp mplist.out <iterations> <number of elements> < DSP
Processor Id >
```

- ☐ *The DSP Processor Id is optional. By default it is zero.*

e.g.

```
$ ./mplistgpp mplist.out 1000 20
```

10.3.8 MESSAGE_MULTIsample

```
$ cd /opt/dsplink/samples/message_multi
```

```
$ ./messagemultigpp messagemulti.out <number of transfers> <Application  
instance number 1 -> MAX_APPS> < DSP Processor Id >
```

- ☐ *The DSP Processor Id is optional. By default it is zero.*

e.g.

```
$ for i in 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16; do ./messagemultigpp  
messagemulti.out 10000 $i & done
```

10.4 Unloadingthekernelmodule:dsplinkk.ko

To unload the device driver, enter following commands on the command prompt.

```
$ cd /opt/dsplink
```

```
$ rmmod dsplinkk
```

D. ADDITIONAL INFORMATION

None.