PSPBoot1.2 User's Guide

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Document # PSP Bootloader User's Guide

Abstract

This document is the user's guide for the PSP Bootloader product and include build instructions, shell commands description, environment variables and FFS documentation, etc.

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1 INTRODUCTION

1.1 Purpose

This document discusses the PSP Bootloader Package (referred to as "PSPBoot"). It describes the Makefiles, configurations, directory structure and files, shell commands and usage, system environment variables, Flash File System (FFS), customization of PSPBoot and writing applications for PSPBoot.

1.2 Reference Documents

The following documents are among the reference material used to develop the PSP Bootloader:

Architecture specific documents for Avalanche I, Avalanche D, Puma S (TNETC4401), Titan (TNETV1050) and Sangam (TNETD73XX) and Apex (TNETV1020) the User Guides for their reference boards.

Books

- "See MIPS Run", Dominic Sweetman, 1999
- "MIPS R4000 Users Manual", Joe Heinrich, 1993

1.3 Tools Used

The following tools are used in developing the PSP Bootloader:

VxWorks for MIPS, Tornado™ 2.1.2 (Wind River Systems)

MontaVista™ Tool chain for MIPS.

Vision ICE II with VisionClick™ (Wind River Systems).

1.4 Abbreviations

BasePSP	Base Platform Support Package
BU	TI Business Unit
CPMAC	TI proprietary Ethernet Interface
DHCP	Dynamic Host Configuration Protocol
DMA	Direct Memory Access
ELF	Executable and Linking Format
FFS	Flash File System
FMM	Flash Memory Manager
GZIP	GNU Zip utility
HAL	Hardware Abstraction Layer

ICE	In-Circuit Emulator
PC	Personal Computer
POST	Power On Self Test
PSBL	Platform Support Package Bootloader
SoC	System On a Chip
SRR	System Resident Routines
UART	Universal Asynchronous Receiver Transmitter
VoB	Versioned Object Base
WLAN	Wireless Local Area Network

2 STARTING UP

To use the PSP Bootloader, it should be built for the respective board and then burned on to the Flash. To build from ClearCase™, only one VoB – `psp_boot` needs to be mounted. Following is the high level features as well as the description for configuring and building it. No particular setup of environment for build is required, except for making sure that the tool-chain intended for build is present in the path. No utility is provided for putting the tool-chain in path. Currently two tool-chains are supported: Tornado™ tool-chain (for build on a windows host) and MontaVista™ tool-chain (for build on a Linux host).

2.1 PSP Bootloader features

Flash File System and Environment variables support

Enhanced Shell engine with command support for OS load, boot, set/get/unset environment variables, Flash usage, etc.

ELF as the standard executable file format, with extended support for BIB format

GZIP decompression utility for ELF files

Auto-detection of file formats for execution

Serial/TFTP/FTP download of images

Distributed application execution from Flash File System or Host machine

DHCP support for dynamic target configuration

Application Framework for developing applications on PSPBoot along with sample applications

PC Application support for control of bootloader from remote host

2.2 POST in PSPBoot

PSPBoot performs minimal POST (Power On Self Test) after it boots up.

As part of POST, the following tests are carried out in order:

- **External SDRAM accessibility Test:** This tests out the accessibility of the external SDRAM.
- **External SDRAM Address Bus Test:** This tests out the address lines [2:18] of the address bus to the External SDRAM.

- **External SDRAM Data Bus Test:** This tests out the data lines [0:31] of the data bus to the External SDRAM.
- **Internal SDRAM accessibility Test:** This tests out the accessibility of the Internal SDRAM.

- **Internal SDRAM Address Bus Test:** This tests out the address lines [2:18] of the address bus to the Internal SDRAM.
- **Internal SDRAM Data Bus Test:** This tests out the data lines [0:31] of the data bus to the Internal SDRAM.

2.3 PSPBoot Configuration

The PSP Bootloader supports configuration options for building it. These options are defined in `sysconf.h`. Some of the configuration options are board and SoC specific and will not be documented here. Following are the common parameters:

- **`CONF_CPU_FREQ`** : Boot CPU frequency
- **`CONF_SYS_FREQ`** : Boot System frequency
- **`CONF_SDRAM_SZ`** : SDRAM size
- **`CONF_FLASH_SZ`** : FLASH size
- **`CONF_CACHE`** : CACHE configuration (Write Back, Write through or None)

2.4 Makefile targets

- **`boot`**: This builds the bootloader images, `psbl.rec` and `psbl.elf`, to be used for burning to the flash at location `0xb000'0000`. The image is placed in `/bin` directory. `boot` option is the default rule for make.

- **`all`**: Same as `boot`

- **`clean`**: clean the Build. Removes all of the .o's and .a's.

The Bootloader Makefile is placed in the top-level directory.

2.5 Build options

The Build option can be provided through `bootcfg.mak` file placed in the top level directory. Following are the build options that should be supplied while invoking the makefile. The values of any of these options provided in `bootcfg.mak` can be overridden by providing another option at the command line.

- **BOARD=<BOARD NAME>**
  This option defines the reference board type. For the latest list of supported boards, please refer to the `bootcfg.mak` file of the latest release. The Platforms supported under WLAN Board type are `TNETWA113VG, TNETWA622, PCI-EVM` and `TNETWA123VAG`

- **ENDIAN=<LE | BE>**
  This option defines Endian type. LE for Little Endian and BE for Big Endian.

- **NETWORK_VEHICLE=<FTP | TFTP | NONE>**
  This option defines protocol to be used for file transfer over the network. Choose FTP for File Transfer Protocol, TFTP for Trivial File Transfer Protocol and NONE for no networking support. Please note that FTP can be used only in the absence of Flash File System (see option FFS)

-DHCP=<YES | NO>
  This option defines if DHCP Support be included in or not.

-PC_APP=<YES | NO>
  This option defined if PC Application support is included or not. PC application can only be compiled in the Little Endian Mode. PC application cannot be used combined with FTP or TFTP support.

- **FFS=<YES | NO>**
  This option defines whether to use TI proprietary Flash File System or not.

- **PLATFORM=<WINDOWS | LINUX>**
  This option defines the tool-chain using which the build is taking place. Use WINDOWS for building using the Tornado™ tool-chain installed on a Windows™ host and LINUX for MontaVista™ tool-chain.

- **CONF_OMOD_GZIP=<YES | NO>**
  This option defines if GZIP decompression support is to be built in or not.

- **CONF_OMOD_ELF=<YES | NO>**
  This option defines if ELF file format support is to be built in or not.

- **CONF_OMOD_TIBINARY=<YES | NO>**
  This option defines if TI Proprietary Binary File Format support is to be built in or not.
- **CONF_OCMD_REBOOT=<YES | NO>**
  This option defines if the '`reboot`' shell command is to be provided or not.

- **CONF_OCMD_VERSION=<YES | NO>**
  This option defines if the '`version`' shell command is to be provided or not.

- **CONF_OCMD_INFO=<YES | NO>**
  This option defines if the '`info`' shell command is to be provided or not.

- **CONF_OCMD_FA=<YES | NO>**
  This option defines if the '`fa`' shell command is to be provided or not.

- **CONF_OCMD_PRINTENV=<YES | NO>**
  This option defines if the '`printenv`' shell command is to be provided or not.

- **CONF_OCMD_SETENV=<YES | NO>**
  This option defines if the '`setenv`' shell command is to be provided or not.

- **CONF_OCMD_UNSETENV=<YES | NO>**

This option defines if the ‘unsetenv’ shell command is to be provided or not.

- **CONF_OCMD_DEFRAGENV=<YES | NO>**
  This option defines if the ‘defragenv’ shell command is to be provided or not.

- **CONF_OCMD_FMT=<YES | NO>**
  This option defines if the ‘fmt’ shell command is to be provided or not.

- **CONF_OCMD_BOOT=<YES | NO>**
  This option defines if the ‘boot’ shell command is to be provided or not.

- **CONF_OCMD_DM=<YES | NO>**
  This option defines if the ‘dm’ shell command is to be provided or not.

- **CONF_OCMD_OCLK=<YES | NO>**
  This option defines if the ‘oclk’ shell command is to be provided or not.

- **CONF_OCMD_HELP=<YES | NO>**
  This option defines if the ‘help’ shell command is to be provided or not.

- **CONF_OCMD_LS=<YES | NO>**
  This option defines if the ‘ls’ shell command is to be provided or not. Without FFS support this option is ignored.

- **CONF_OCMD_DF=<YES | NO>**
  This option defines if the ‘df’ shell command is to be provided or not. Without FFS support this option is ignored.

- **CONF_OCMD_CP=<YES | NO>**
  This option defines if the ‘cp’ shell command is to be provided or not. Without FFS support this option is ignored.

- **CONF_OCMD_CAT=<YES | NO>**
  This option defines if the ‘cat’ shell command is to be provided or not. Without FFS support this option is ignored.

- **CONF_OCMD_RM=<YES | NO>**
  This option defines if the ‘rm’ shell command is to be provided or not. Without FFS support this option is ignored.

- **CONF_OCMD_TFTP=<YES | NO>**
  This option defines if the ‘tftp’ shell command is to be provided or not. Without TFTP support this option is ignored.

- **CONF_OCMD_FTP=<YES | NO>**
  This option defines if the ‘ftp’ shell command is to be provided or not. Without FTP support this option is ignored.

After building the bootloader image, it is burned onto the Flash at a base address of `0xb000'0000` using VisionCLICK. Refer to the next section *`Burning BootLoader on Flash'* for details.

2.6 Burning Bootloader on Flash

2.6.1 Burning PSPBoot with VisionICE

The following procedure should be used for burning the bootloader on flash using VisionICE.

Step 1 – Convert the bootloader S-RECORD file to the visionCLICK binary file format:

In order to load a file into flash memory, visionCLICK™ requires that the file be in visionCLICK™ BIN format. Typically, we do not include this file format in the bootloader software distribution, but we do provide S-Record format versions of the bootloader kernel. Therefore, the first step is to convert the bootloader kernel from S-Record format to the visionCLICK™ BIN format. Note that this step is not required if you already have the visionCLICK™ BIN format version of the bootloader kernel for your platform.

1. From the visionCLICK™ menu, click on `File`, and then `Open Project Files / Load Options` Dialog. The `PROJECTS / LOAD` dialog box is displayed.
2. Click the `Load Options` tab, then click the `Convert`… button
3. In the `CONVERT BINARY AND SYMBOL OBJs` dialog box:

   Enter the filename of the bootloader kernel file you want to convert in the `Select Input Object Module To Convert` field. Bootloader S-Record files have a filename extension of .rec
   Mark the check box to `Create Flat BIN File For Flash Programming` and input the range of 90000000 to 9003FFFF. Clear all other check boxes. Enter the destination filename where you wish the resulting visionCLICK™ BIN format file to be placed.
   Enter –s in the `Miscellaneous Parameters` field. This specifies that the input file be in S-Record format.
   Click the `Convert` button to perform the conversion. An MS-DOS window will display the results of the conversion process. Press any key to close the MS-DOS window.
   Click the OK button to close the `CONVERT BINARY AND SYMBOL OBJs` dialog box.

Step 2 – Write the converted BIN file to your platform's flash memory

1. After performing Step 1, the `Load Options` tab of the `PROJECTS / LOAD` dialog box should be displayed. If not, then from the visionCLICK menu, click on `File`, and then `Open Project Files / Load Options` Dialog. Then click the `Load Options` tab.

2. Click the `Flash Setup…` button
3. In the `TF FLASH PROGRAMMING` dialog box…

   Enter the filename of the visionCLICK™ BIN format file created in Step 1 above in the `Flash Card or PC Host File Name and Path (0 Bias)` field.
   Select the appropriate flash device used on your platform in the `Programming Algorithm` field. See the table below.
   Enter B0000000 in the `Base Address` field, and click the `Erase All` radio button. The whole flash should be erased for the first time only.
   Enter A0000000 in the `Start Address` field.
   Click the `Erase and Program` button. The specified BIN file will be loaded into flash.
   Reset your platform to execute the newly loaded flash code.

The following table gives the VisionICE flash settings for currently supported Reference Boards.

Reference Board	Flash Device Choice for VisionClick™
AR7VDB	INTEL 28F128Jx (8192 x 16) 1 Device
AR7DB / AR7RD / AR7WRD / AR7VWi / AR7L0 / AR7Wi	AMD 29DL32xxB(2048 x 16) 1 Device
TNETV1050VDB	AMD 29DL32xxB(2048 x 16) 2 Devices
TNETV1050SDB	INTEL 28F320C3T(2048 x 16) 2 Devices
TNETC401B	INTEL 28F320Jx (2048 x 16) 1 Device
TNETC620	INTEL 28F320C3B(2048 x 16) 1 Device
TNETC621	INTEL 28F320C3B(2048 x 16) 1 Device
WLAN	INTEL 28F320C3B(2048 x 16) 1 Device
TNETC520	INTEL 28F320C3B(2048 x 16) 1 Device
TNETC420	INTEL 28F160C3B(2048 x 16) 1 Device
TNETC405T	INTEL 28F160C3T(1024 x 16) 1 Device
TNETV1020VDB	INTEL 28F128Jx (8192 x 16) 1 Device

2.6.2 Burning PSPBoot with BDI 2000

2.6.2.1 Installing BDI2000 Software.

Unzip the Host software provided with BDI2000 onto the local disk. This installs the BDI2000 software on the Host PC.

2.6.2.2 Configuring BDI2000 for MIPS

BDI2000 has to be configured for running with MIPS processor. To configure BDI2000 for MIPS, please follow the instructions given in *Section 2.5 - Installation of the Configuration Software* from the BDI2000 user manual.

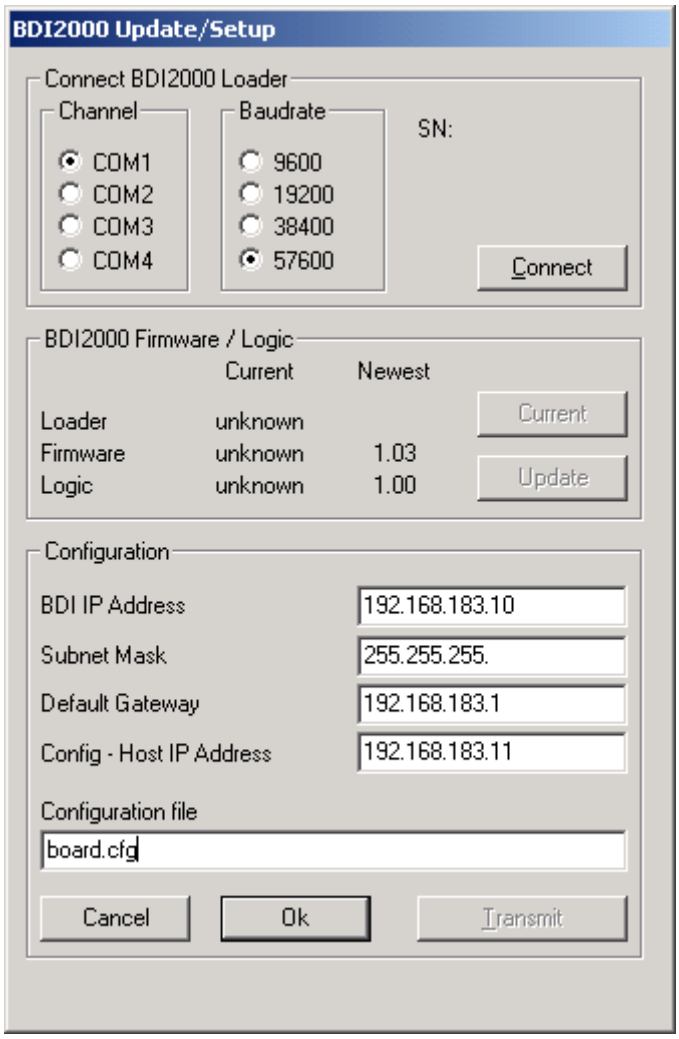
2.6.2.3 Establishing EJTAG connection to BDI2000

1. Connect the BDI2000 Emulator to DUT using the EJTAG port.
   Warning: Pay special attention to the EJTAG connector pin orientation. Failing to connect with proper orientation may lead to damage of the DUT or BDI2000 or both.

2. Use a Null Modem cable to establish a serial connection between Host PC and the BDI2000.

3. Connect the BDI2000 to the Local network using Ethernet Cable.
   Warning: Power up sequence between BDI2000 and DUT is important. On power-up of the system, first power-up the BDI only then the DUT. On system power-down, first power-down the DUT and only then the BDI2000.

4. Run the executable "B20R4KGD.EXE" provided with the BDI Software.
   From the GUI menu, select `Setup` → `BDI2000`...
   By default, BDI2000 comes up with a baud rate of 57600.



Fill up the fields under "`Connect BDI2000 Loader`" and "`Configuration`". The configuration file to be provided is a board specific configuration file. The details of the configuration file will be discussed later. At this stage, only name of the configuration file is taken by BDI2000.

Now press the connect button. On success, you should see the SN field updated. The `Transmit` button is also enabled. Press the `Transmit` Button now. All the Data entered is saved with BDI2000. Once the data is updated to BDI2000, there is no further need of the serial connection. Power Cycle the BDI2000 now.

5. After Reboot BDI uses TFTP the protocol to download configuration files from the Host PC. The configuration files accessed are `reg4kc.def` (provided with the installation software) and the board specific configuration file configured in the previous step. After successfully downloading these files, BDI2000 initializes the target.

6. Connect to BDI2000 by using telnet. BDI prompt should be available. Typing `help` at this prompt gives a list of supported commands along with a brief description.

2.6.2.4 Erasing and programming the flash using BDI2000

Use the command `erase` at the BDI telnet prompt to erase the flash.
The command `erase <address>` erases sector starting with that address. `erase` called without arguments takes the sectors to be erased from the board configuration file.

Use the command `prog` to program `psbl.bin` into flash. The name of the file to be programmed and the address to start the program, can be configured using the configuration file.

2.6.2.5 Using the board specific configuration file

A brief description of various sections of the configuration file is given here. For more detailed explanation, please refer to the BDI2000 user manual.

[INIT]

Optional section. Use this to perform any specific initializations. Examples: EMIF initialization, TLB initialization, invalidating data and instruction cache or unlocking of flash blocks for Intel flash chips. See example below.

[TARGET]

1. *JTAGCLOCK*
   Configures the JTAG clock rate that BDI2000 uses when communicating with the target CPU.

2. *CPUTYPE*
   Set to `M4KC`.

3. *ENDIAN*
   Defines whether the target CPU is in Big or Little Endian mode.

4. *STARTUP*

Set to RESET.

[HOST]

1. *IP*
   The IP address of the Host PC.

2. *PROMPT*
   The Telnet prompt string.

[FLASH]

1. *WORKSPACE*
   The flash programming workspace. This should be pointed to internal RAM (`0xA0000000`)

2. *CHIPTYPE*
   This parameter defines the type of flash used. It is used to select the correct programming algorithm.
   Supported formats: AM29F, AM29BX8, AM29BX16, I28BX8, I28BX16, AT49, AT49X8, AT49X16, STRATAX8, STRATAX16, MIRROR, MIRRORX8, MIRRORX16

3. *CHIPSIZE*
   The size of **one** flash chip in bytes

4. *BUSWIDTH*
   The width of the memory bus that leads to the flash chips.

3. *FILE*
   Name of the file to be used for flash programming (`psbl.bin`)

4. *FORMAT*
   The format of the image file and an optional load address offset. For `psbl.bin` the format is BIN. This entry also defines the address where the file is programmed into the flash.

5. *ERASE*
   The flash memory may be individually erased via the Telnet interface. In order to make erasing of multiple flash sectors easier, you can enter an erase list. All entries in the erase list will be processed if you enter `erase` at the Telnet prompt without any parameter.

   Example:

```
ERASE 0xb0000000           ;erase sector 0 of flash
ERASE 0xb0010000           ;erase sector 1 of flash
```

   NOTE: Some Intel flash chips (e.g. 28F800C3, 28F160C3, 28F320C3) power-up with all blocks in locked state. In order to erase/program those flash chips, use the init list to unlock the appropriate blocks.

```
WM16 0xB0000000  0x0060    ; unlock block 0
WM16 0xB0000000  0x00D0
WM16 0xB0010000  0x0060    ; unlock block 1
WM16 0xB0010000  0x00D0
WM16 0xB0000000  0xFFFF    ; select read mode
```

2.6.2.6 Flash settings for currently supported boards

Following table defines the various settings for currently supported flash types.

Reference Board	Chip Type	Chip Size	Bus Width
AR7VDB	AM29BX16	0x400000	16
AR7DB / AR7RD / AR7Wi / AR7VWi / AR7WRD / AR7L0	AM29BX16	0x400000	16
TNETV1050VDB			
TNETV1050SDB	I28BX16	0x1000000	32
TNETC401B			
TNETC620			
TNETC621			
WLAN	I28BX16	0x200000	16
TNETC520			
TNETC420			
TNETC405T			
TNETV1020VDB	AM29BX16	0x1000000	16

2.7 PSPBoot File and Directory Structure

2.7.1 Directory Structure

Directory Path/Name	Purpose
psp_boot	PSPBoot directory
psp_boot\apps	PSPBoot applications directory
psp_boot\bin	PSPBoot binary images
psp_boot\lib	PSPBoot libraries
psp_boot\inc	PSPBoot headers directory
psp_boot\inc\psbl	PSPBoot headers
psp_boot\inc\apps	PSPBoot application headers
psp_boot\psbl	PSPBoot sources
psp_boot\psbl\gzip	PSPBoot compression sources
psp_boot\psbl\kernel	PSPBoot kernel sources
Psp_boot\psbl\kernel\cmd	PSPBoot command sources
psp_boot\psbl\net	PSPBoot network sources
psp_boot\tools	PSPBoot tools/utilities
Psp_boot\docs	PSPBoot Documentation
Psp_boot\export	PSPBoot files exported for environment and FFS support.

2.7.2 Files List

File Name	Purpose
Makefile	PSP Bootloader Makefile
Readme.txt	Bootloader howto
rules.mak	Makefile rules for inclusion in sub-directory makefiles
psbl.xn	Bootloader linker Script
debug.h	Debug Support Header File
elf.h	ELF header file
env.h	Environment Variables Header File
fmm.h	Flash Memory Manager Header File
errno.h	Error codes
ffs.h	Flash File System Header File
flashop.h	Flash HAL Header File
heapmgr.h	Heap Manager Header File
hw.h	Hardware definitions
mips.h	MIPS processor Definitions
revision.h	Revision Logs
sysconf.h	Buildable Configuration Parameters
stdarg.h	Stdarg header file
stdio.h	Standard I/O Include File
stddef.h	Standard Definitions and Typedefs
system.h	System Header File
crc32.c	Gzip CRC file
/psbl/gzip/*.[ch]	Gzip Header files
mips4k_init.S	Processor initialization routines

platform_init.S	SoC initialization routines
srt0.S	System startup routines
avreset.h	SoC specific header file
fcb.h	FCB header file
ffs_extra.h	FFS extra routines header file
ffs_util.h	FFS Utilities Header File
files.h	Files abstraction header file
gdb_stub.h	GDBL debug header file
load_bin.h	Binary file load header file
load_elf.h	Elf file load header file
loadfile.h	File loading header file
main.h	Main.c specific header file
mms.h	Dynamic Memory Management Routines Header File
shell.h	Shell header file
sio.h	Serial interface header file
support.h	Ctypes header file
sysdefs.h	System Defintions Header File
env.c	Environment Variable Routines Source File
fmm.c	Flash Memory Manager Source File
exception.c	Exceptions support Source File
fcb.c	FCB source file
ffs.c	FFS Routines Source File
ffs_extra.c	Extra FFS routines Source File
ffs_util.c	FFS Utilities Source File
files.c	Files abstraction Source File
flashop_istrata_16.c	Flash HAL (Intel Strata 16-bit Flash) Source file
flashop_istrata_32.c	Flash HAL (Intel Strata 32-bit Flash) Source file
flashop_amd_16.c	Flash HAL (AMD 16-bit Flash) Source file
heapmgr.c	Heap Manager Source File
load_bin.c	Binary load Source File
load_elf.c	Elf load Source File
loadfile.c	File loading Source File
main.c	C startup routines Source File
mms.c	Dynamic Memory Management Routines Source File
printf.c	Printf Source File
shell.c	Shell support Source File
sio.c	Serial Interface Source File
support.c	Ctypes Source File
i2c_defs.h	I2C defines
i2c_hal.c	I2C HAL sources
i2c_hal.h	I2C HAL header file
cpmac.c	CPMAC HAL source
cpmac.h	CPMAC HAL header
arp.c	ARP source
arp.h	ARP header
ether.c	Ethernet layer packet handling source
ether.h	Ethernet layer header
ip.c	IP layer routine source
ip.h	Ip layer header

net.h	General network header
tftp.c	TFTP protocol routine source
tftp.h	TFTP protocol header
udp.c	UDP layer routine source
udp.h	UDP protocol header
tinydhcp.c	DHCP protocol source
tinydhcp.h	DHCP protocol header
/lib/*.c	Stdlib and string library sources
/psbl/kernel/cmd/*.c	Command sources

2.8 Supported Flash Devices

These are the Flash devices currently supported on PSPBoot. (Found on various reference boards).

Flash Type	Part Number	Flash HAL file
AMD Flash	AMD AM29LV320D	flashop_amd_16.c
Intel Strata Flash	E28F320-J3A1110	flashop_istrata_16.c
Intel Strata Flash	E28F128-J3C150	flashop_istrata_16.c
Intel Strata Flash	DA28F640J5-150	flashop_istrata_32.c
Intel Strata Flash	E28F160-C3TA110	flashop_is1050_16.c
Intel Strata Flash	E28F320-C3TA110	flashop_is1050_16.c
Intel Strata Flash	E28F640-C3TC80	flashop_is1050_16.c
Atmel Flash	AT49LV320-90TI	flashop_atmel_32.c
Intel Advanced+ C3	TE28F320C3TC90	flashop_ic3.c

3 BOOTLOADER USAGE AND SHELL COMMANDS

The PSP Bootloader is to be used with the **`sead1.exe`** application running on host as a serial terminal for the emulation board. This application supports file download/upload from/to the host to the target board via the serial interface. The `sead1.exe` terminal defaults to 38400 baud with hardware flow control and port 1. To specify a baud rate, for e.g. 9600, with no hardware flow control, and connect to serial port 2, run from the DOS as:

```
Z:\psp_boot\bin> sead1.exe –b 9600 –f –p 2
```

After reset, if the BOOTCFG environment variable is set, the bootloader comes up and tries to load the default OS boot image. It waits for 3 seconds for the user to break to the shell prompt, if desired. For doing so, user should hit the ESC key when prompted. While booting the OS image by default, if the image is not found, it falls to the shell. If the BOOTCFG environment variable is not set, the bootloader automatically falls to shell. For detailed description on the usage of BOOTCFG environment variable, please refer to the description of '`boot`' command.

Following is the screen shot for jumping to the shell prompt:

```
PSPBoot1.1 rev: 1.0.2
(c) Copyright 2002-2003 Texas Instruments, Inc. All
Rights Reserved.

Press ESC for monitor... 1     # Press ESC key for shell
(psbl)                         # Bootloader prompt
```

The shell prompt is available for commands execution. The shell buffer size is 150 bytes. .

Following in this section is a list of commands that are built-in. Applications can also be built for running with the shell. These application execution is distributed and can reside either on the host machine in the directory where from `sead1.exe` is running, or can be copied to the FFS in the `/bin` directory. The order of execution for PSPBoot is:

```
Builtin     – bootloader built-in commands
/bin        - applications in FFS, dir /bin
/ttyS       – applications on Host,using serial interface
```

The path for execution of files on FFS can be changed using the PATH environment variable. The built-in commands are always executed first. They cannot be overridden by executables placed in the FFS. The FFS is installed in the flash by use of the '`fmt`' command.
Applications for execution from the shell should be in either of ELF format, Gzipped ELF format or TI binary format.

3.1 Bootloader built-in commands

Following is the list of Bootloader built-in shell commands with their descriptions and usage. At the end is provided a sample usage for booting an OS image.

3.1.1 tftp

```
Usage: tftp  [-i  <server-ip>] <srcfile> <dstfile>
       tftp  [-r] <srcfile> [optional arguments]
```

Description:
This command downloads the `srcfile' from a given host to `dstfile' on FFS, over the network using TFTP protocol. The host should be running TFTP server to support the file download. This command can also be used to download an executable file directly to RAM and start its execution. If 'dstfile' is missing TFTP to RAM is assumed. If arguments need be passed to the executable, '-r' option should be used. Note that files non-executable for the platform cannot be downloaded to RAM.
This tftp module depend on environment variables for relevant network related information. They are:

- HWA_[0|1] : System MAC address.
- IPA : System IP address.
- IPA_SVR: Target (or TFTP server) IP address, running tftp server.
- IPA_GATEWAY: The IP Address of the Gateway for the subnet in which the target is present. This parameter is not required if IPA and IPA_SVR belong to the same subnet.
- SUBNET_MASK: The Subnet Mask for the subnet in which the target is present.
- MAC_PORT: The active MAC port number. (Valid values 0 or 1).
- TFTPCFG: (Optional) Configuration of Re-transmissions count and time-out time in seconds.

The server IP address, configured in the environment variable can be overridden if the server-ip is given in the command line.

The TFTP server should be configured to transfer data packets of 512 byte-blocks.

NOTE:

- This command doesn't support file upload to the server.

[-i <server-ip>]
Host IP, running tftp server. This option overrides the IPA_SVR environment variable.

[-r]
Download 'srcfile' directly to RAM. Any following arguments ([Optional arguments]) are considered as arguments to 'srcfile'

<srcfile>
File to retrieve from the tftp server.

`<dstfile>`

If FFS is built in, this should be a file name with path, to copy `srcfile` to. In case FFS is not built in, this should be an environment variable of the format base_address,end_address. (both addresses in Flash) (eg 0x90200000,0x90300000) In this case, `srcfile` will be copied to the raw flash, starting at the base address specified.

`See Also`:
cp

3.1.2 oclk

```
Usage: oclk –d
       oclk <[-s sys_freq] [cpu_freq]>

Note:  sys_freq and cpu_freq are specified in MHz units.
```

`Description`:
This command supports run-time configuration of system and CPU frequencies.

For the SYNC mode, either of the CPU or System frequency can be provided. In this mode, only the System frequency is configured.

`[-d]`

Dump the current configuration of both CPU and System frequencies.

`[-s <sys_freq>]`

System frequency for configuration. If provided value is out of valid range, it is configured to the closest valid frequency. A value of zero leads to the System frequency value remaining unchanged.

`[cpu_freq]`

CPU frequency for configuration. If provided value is out of valid range, it is configured to the closest frequency. A value of zero leads to the CPU frequency value remaining unchanged.

Important Note:

1. The oclk command sets the CPU and System Frequency only in steps of 12.5 MHz starting from the minimum value and going upto the maximum permissible value.
2. oclk command does not accept floating point values as input for system and CPU frequency.
3. For a given input of System or CPU frequency, the nearest multiple of 12.5 MHz *lower* to the asked frequency is set. For example, To set the CPU frequency to 32.5 Mhz, use:
   `(psbl) oclk 33`

SoC Name	Synchronous Mode*		Asynchronous Mode	
	Min Freq (MHz)	Max Freq (MHz)	Min Freq (MHz)	Max Freq (MHz)

TNETD73XX	25	125	25	150
TNETV1050	25	125	25	162.5
TNETD53XX	25	125	25	125
TNETV1020	100	350	100	350

* In TNETV1020, Synchronous mode denotes MIPS-2-TO-1 mode.

See Also:
sysconf.h for default boot frequency.

3.1.3 boot

Usage: boot

Description:
Boot up an OS image from the FFS/Network. The boot image and the order of boot is configurable with the environment variable, BOOTCFG. BOOTCFG has the following format

<method of getting configuration>:<order of boot>:<boot-image>

The valid values are:

<m|d>:<[f][n]>:<a|"bootfile">

'm' stands for manual configuration. In this case DHCP will not be invoked. All the configuration must be made manually.

'd' stands for DHCP configuration. All valid information that DHCP server provides will be taken.

'f' stands for execute image stored in Flash

'n' stands for boot from network using TFTP

'a' stands for auto boot-file configuration ie. Let the DHCP server provide the filename to boot. This option is invalid if 'm' is selected. The boot-file provided by DHCP server can be over-ridden by providing an alternate file-name in double-quotes. In case of manual configuration, provision of bootimage name is must.

Boot Order

f : boot from flash only

n : Attempt to download the boot-image by TFTP and boot.

fn : Attempt to boot from the flash first, if it fails, attempt to download the

bootimage from network to flash and boot from flash.

`nf` : Attempt to download the boot-image from network to RAM and boot, if it fails, boot from flash. No update of flash is done.

`Boot File`

`a` : Use the boot-image name provided by DHCP server. If FFS is used, the boot-image name is searched in /bin directory. If FFS is not used, boot-image name will be treated as an environment variable of the type `start_address,end_address`. Attempt will be made to boot by reading the image from flash starting at `start_address`. If manual configuration is used, this option is invalid and will result in boot failure.

`"filename"`: If FFS is used, the `filename` is searched in /bin directory. If FFS is not used, `filename` will be treated as an environment variable of the type `start_address,end_address`. Attempt will be made to boot by reading the image from flash starting at `start_address`. If DHCP is used, this option can be used to override the filename provided by DHCP server. If manual configuration is used, this option is must.

`See Also`:
`setenv`

3.1.4 df

`Usage`: `df`

`Description`:
Display raw flash device usage statistics by FFS. This command is not supported if FFS is not present.

`See Also`:
`ls`

3.1.5 fmt

`Usage`: `fmt [-a start_address,end_address] [Environment Variable]`

`Description`:
If FFS is present, this command with no arguments, formats the FFS. Following a format, it creates the directories, /bin, /etc and /ttyS. All of the previously existing files will be erased.

Usage of this command with no arguments in absence of FFS is invalid.

fmt can be called with -a option, in which it takes a start address and end address and erases the flash area between those addresses.(End address excluded in case of block aligned addresses) Eg

```
fmt –a 0x90200000,0x90300000
```

The same effect can be achieved by the use of an environment variable of the format start_address,end_address. (both addresses in Flash) (eg 0x90200000,0x90300000). In this case fmt will erase flash area starting at the start_address till the end_address. Eg.

```
(psbl) setenv MTD0 0x90200000,0x90300000
(psbl) fmt MTD0
```

See Also:
ls, setenv

3.1.6 setenv

Usage: `setenv <ENV NAME> <env value>`

Description:
Set/Update a system environment variable. The environment variables can be predefined and listed in `env.c`. (placed in `psp_boot\psbl\kernel`). Environment variables can also be created dynamically. Please note that usage of dynamic environment variables will lead to wastage of environment space as both the variable and the value string will be stored on the flash. It is suggested that dynamic variables be used only for debugging/development purposes. Once the system is ready for deployment, pre-defined variables should preferably be used.

Please note that both the environment variable and value are case-sensitive.

The command `setenv` will automatically de-fragment the environment space if the environment space is exhausted and if there is garbage left to be collected. This de-fragmentation is however, not power-fail safe. Setting the macro `AUTO_DEFRAG_ENVIRONMENT` in `env.h` to `FALSE` will turn off the auto de-fragmentation

`<ENV NAME>`
Defines the name of the new Environment Variable.

`<env value>`
Defines the value of the new environment variable.

See Also:
unsetenv, printenv, defragenv

3.1.7 unsetenv

Usage: `unsetenv <ENV NAME>`

Description:
Delete an environment variable.

<ENV NAME>
Environment Variable name.

See Also:
setenv, printenv

3.1.8 ls

Usage: `ls`

Description:
List information about the files/directories in the FFS. In case FFS is not used, this command is not supported.

3.1.9 cp

Usage: `cp <srcfile> <dstfile>`

Description:
This command copies a given file, `srcfile', to `dstfile'. Both of the file arguments should be provided with appropriate path. `cp' can copy files from FFS to the Serial File System and vice-versa. This command can also be used to copy files within the Flash File System.

<srcfile>
Source filename, to copy from.

<dstfile>
Destination filename, to copy source file to.

In case FFS is not used, this command is not supported.

Example:
```
(psbl) cp /ttyS/app.bin /bin/app
```

See Also:
tftp

3.1.10 rm

Usage: rm <file>

Description:
This command removes a file from the Flash File System. Only the file node is freed from FFS. The actual space occupied by the file being removed is not restored to FFS. For restoring the space to FFS, de-fragmentation of FFS should be run, In case FFS is not used, this command is not supported.

<file>
File with the whole path, to be removed.

Example:
```
(psbl) rm /bin/app
```

See Also:
cp

3.1.11 reboot

Usage: reboot

Description:
This command reboots the whole system and brings it up as during a normal power-up reset.

3.1.12 dm

Usage: dm [<hex address> [num words]]

Description:
Display memory contents from the defined location. If the parameter num words is not given, it dumps 128 bytes form the given address. The user can break the memory dump and return to prompt at any time while the dump is taking place by pressing the ESC key.

Issuing the command without any parameters will display the memory starting at the last displayed address. If there is no last displayed address, then this command will dump the memory starting at 0xb4000000.

hex address
Starting Address, in hex, to display the memory contents from.

num words
Defines the number of words of memory to be dumped.

3.1.13 printenv

Usage: printenv
printenv envlist

Description:
Print all of the system environment variables, which are used. Giving the envlist option prints all the environment variable which are listed. (All the pre-defined variables)

See Also:
setenv, unsetenv

3.1.14 cat

Usage: cat <file>

Description:
Print file to the shell, in ASCII. In case FFS is not used, this command is not supported.

Example:
(psbl) cat /etc/config.txt

3.1.15 help

Usage: help [cmd]

Description:
Display the list of bootloader built-in commands (when called with no arguments) or provide help on a specified command.

[cmd]
command to fetch help on.

3.1.16 defragenv

Usage: defragenv

Description:
This command de-fragments the environment space. De-fragmentation involves removal of obsolete (deleted or updated) environment entries. This command is not completely power fail-safe and should be used with caution.

3.1.17 ftp

Usage: ftp [-b] net_file env_var
ftp -p

Description:
This command transfers a file from the host machine to the raw flash using the File Transfer Protocol. net_file is the name of the file to be fetched from the remote machine. env_var is an environment variable which has a value of the form start_address,end_address. (both addresses in Flash) (eg

0x90200000,0x90300000). ftp will fetch the remote file and burn it in the flash starting at the address specified in the environment variable. (start_address)

CAUTION: This command should not be used with FFS as this will corrupt the installed FFS.

The ftp command depends on environment variables for relevant network/authentication related information. They are:

- `HWA_[0|1]` : System MAC address.
- `IPA` : System IP address.
- `IPA_SVR` : Target (or FTP server) IP address, running FTP server.
- `IPA_GATEWAY`: The IP Address of the Gateway for the subnet in which the target is present.
- `SUBNET_MASK`: The Subnet Mask for the subnet in which the target is present.
- `REMOTE_USER`: The user name on the remote machine.
- `REMOTE_PASS`: The password on the remote machine. Stored in an encrypted format.
- `REMOTE_DIR`: The directory on the remote machine in which the remote file is present
- `MAC_PORT` : The active MAC port number.

`[-b]`
This option checks if the start_address passed to the ftp command (through env_var) is block aligned or not. If not block aligned, ftp when used with –b option returns error.

`-p`
When FTP is called with this option, it prompts for the remote password and stores it in an encrypted format.

3.1.18 fa

`Usage: fa`

`Description`:

This command prints the flash memory allocation information. While printing the allocation for the bootloader, it prints the exact size of the bootloader instead of printing the size rounded to the nearest block. This provision helps determine the PSPBoot image size exactly.

The allocations for PSPBoot image, the environment space and FFS (if compiled in) are shown by default. Also information about amount of unallocated (free) space in flash is displayed.

3.1.19 info

`Usage: info`

`Description`:

This command prints the SoC name and revision number. It also displays various SoC related information like Cache size etc.

3.1.20 version

`Usage: version`

`Description`:

This command will print the PSPBoot version, build information and the optional modules included.

4 SYSTEM ENVIORNMENT VARIABLES

The environment variables supported in the system provide means for configuration data retention across power-cycles as well as parameter sharing between bootloader and it's applications (OS inclusive). These variables are stored as a sort of file system on the Flash, in a contiguous erasable block.

This document cover the APIs required to configure and initialize the environment variables, describes how to add a new pre-defined variable for the system.

4.1 Customizing Environment Support

The location of the Flash Erase Block(s) where environments will be stored is determined by configuration using the Flash Memory Manager.

The Flash Memory manager will allocate a minimum of one erase block for storing the environment variables. Configuration can however be made to store environment variables only in a part of the block allocated. For making such a configuration, the macro `'ENV_SPACE_SIZE'` in `'inc/psbl/env.h'` should be set to the size of the environment space required. PSPBoot will not touch the remaining space in the erase block allocated. It can be used to store any application specific information. For Example, the NSP configuration is stored in such a manner.
Configuration can also be made to de-fragment the environment space automatically after the environment space fills up. This de-fragmentation is carried out only when an attempt is made to set an environment variable (See `setenv`). After the de-fragmentation, the set command is called again with same set of arguments. This de-fragmentation is carried out only if there is garbage left to be collected. By default auto de-fragmentation of environment space is turned on. To turn it off set the macro `AUTO_DEFRAG_ENVIRONMENT` in `'inc/psbl/env.h'` to `FALSE.`

4.2 Environment API List

4.2.1 sys_initenv

`Name: sys_initenv -` initialize the environment variables module

```
Synopsis:
#include <env.h>

int sys_initenv(void);
```

`Description:`
This function validates the environment existing on the system, and if successful, initializes the internal data structures for access to the environment variables.

This routine should be called before using the environment variables.

Return Value:
Upon successful execution, SBL_SUCCESS is returned.

Errors:
SBL_EINVALID:
The environment file system is not of PSP Bootloader type. Under such conditions, environment variables cannot be used. The bootloader should be run again to install the appropiate environment type.

4.2.2 sys_setenv

Name: sys_setenv - update an environment variable

Synopsis:

```
#include <env.h>

int sys_setenv(char *env_var, char *val);

   env_var: Environment variable to be created.
   val:     Environment variable value, as string.
```

Description:
The sys_setenv() will update an environment variable of the system. The variable, identified with env_var will be set to value to which val points. If env_var was not created earlier, this call will create a new instance of it. Else, if the new val is different from the existing value, it will delete the earlier value and configure the variable to point to the new value, val.

The string supplied by val will be copied by this routine.

sys_setenv() is not re-entrant. Care should be taken by the caller to support thread-safe execution.

Return Value:
Upon successful execution, SBL_SUCCESS is returned.

Errors:
SBL_ERESCRUNCH:
Insufficient memory in environment variables file system. Run the bootloader and defragment the environment space.

SBL_EINVALID:
Either sys_initenv() is not executed or the environment variable type is undefined. Refer to error SBL_EINVALID description in sys_initenv().

SBL_EFAILURE:
This identifies a Checksum error or data abuse or data corruption of the environment file system. On such error, sys_setenv() will not successfully execute. Run the PSP bootloader to format and install it's environment file system.

4.2.3 sys_getenv

Name: sys_getenv - get value of an environment variable

Synopsis:

```
#include <env.h>

char *sys_getenv(char *env_var);

    env_var:  Environment variable.
```

Description:

The sys_getenv() function will search the environment variables file system for the given variable, env_var, if it exists and return a pointer to the value of the same. If the specified variable cannot be found, a null pointer will be returned.

The value, returned as a string, should not be modified by the caller. On doing so, the behavior is undefined. Instead, the caller should copy the string to another location for any processing.

sys_getenv() is not re-entrant. Care should be taken by the caller to support thread-safe execution.

Return Value:

Upon successful completion, sys_getenv() will return a pointer to the string containing the value of the specified env_var. If the specified env_var cannot be found on the environment file system or not defined in the list of supported environment variables for this system, it will return a NULL pointer.

4.2.4 sys_unsetenv

Name: sys_unsetenv - delete an environment variable

Synopsis:

```
#include <env.h>

char *sys_unsetenv(char* env_var);

    env_var:  Environment variable identifier.
```

Description:

The sys_unsetenv() function will remove an environment variable, env_var, from the environment file system. If the environment variable is not listed for system, then the environment file system will remain unchanged and the function is considered to have completed successfully.

sys_unsetenv() is not re-entrant. Care should be taken by the caller to support thread-safe execution.

Return Value:

Upon successful execution, SBL_SUCCESS is returned.

Errors:
SBL_EFAILURE:
This identifies a Checksum error or data abuse or data corruption of the environment file system. On such error, sys_setenv() will not successfully execute. Run the PSP bootloader to format and install it's environment file system.

SBL_EINVALID:
Either sys_initenv() is not executed or the environment variable type is undefined. Refer to error SBL_EINVALID description in sys_initenv().

4.2.5 sh_printenv (shell command)

Name: sh_printenv - dump the environment variables on the shell

Synopsis:

```
#include <env.h>

int sh_printenv(void);
```

Description:
The sh_printenv routine prints all of the environment variables for the system on the shell. This is targeted for the debug environment.

Return Value:
Upon successful execution, SBL_SUCCESS is returned.

Errors:
SBL_EINVALID:
Either sys_initenv() is not executed or the environment variable type is undefined. Refer to error SBL_EINVALID description in sys_initenv().

4.3 Pre-defined Environment Variables

Following is the list of the environment variables supported for the system. Some of these environments may not be available based on the SoC for which PSPBoot is compiled.

```
CPUFREQ      CPU Frequency (Read Only).

SYSFREQ      System Frequency (Read Only)

MEMSZ        System Memory Size. If this variable is found to be
             unset at boot-time, it will be set to the value taken
             from sysconf.h

FLASHSZ      System Flash Size. If this variable is found to be
             unset at boot-time, it will be set to the value taken
             from sysconf.h

MODETTY0     Serial Port 0 Working Mode.
```

	The mode parameters comprise of baud rate, parity, data bits, stop bits and flow-control mechanism. For a port configuration of 9600 baud, no parity, 8 data bits, 1 stop bit and hardware flow-control, it should be configured as: 9600,n,8,1,hw. If this variable is found to be unset at boot-time, it will be set to a default value of 9600,n,8,1,hw.
MODETTY1	Serial Port 1 Working Mode. Format is the same as for MODETTY0.
PROMPT	Bootloader shell prompt. This variable is read at boot-time only. If this variable if found to be unset at boot-time it will be set to default value of “psbl”
BOOTCFG	Boot Configuration.(find more details in documentation of ‘boot’ command)
HWA_0	Hardware Address for the first Ethernet MAC interface. The delimiters for the octects can be any of “.-:_” (excluding the double quotes), for example: 00.e0.a6.66.39.54
HWA_1	Hardware Address for the second Ethernet MAC interface.
HWA_RNDIS	Hardware Address, for RNDIS interface. (Target side)
HWA_3	Hardware Address, for Ethernet-over-ATM interface.
HWA_HRNDIS	Hardware Address, for RNDIS interface. (Host side)
IPA	System IP Address.
IPA_SVR	TFTP/FTP Server IP Address.
IPA_GATEWAY	Target’s Gateway IP address.
SUBNET_MASK	Target’s Gateway IP address.
BLINE_MAC0	Bootline ascii string for VxWorks with initialization parameters for CPMAC-0 interface. These parameters hold boot device name, unit number, internet addresses for the host and the interface, network mask, user name and password. A sample BLINE_MAC0 string is: cpmac(0,0)host:file h=192.138.139.235 e=192.138.139.81:FFFFFF00 u=titan pw=titan
BLINE_MAC1	Bootline parameters for CPMAC-1 interface.

A sample BLINE_MAC1 string is:
cpmac(1,0)host:file h=192.138.139.235 e=192.138.139.82:FFFFFF00 u=titan pw=titan

BLINE_RNDIS Bootline parameters for RNDIS interface.

A sample BLINE_RNDIS string is:
rndis(2,0)host:file h=192.138.139.235 e=192.138.139.83:FFFFFF00 u=titan pw=titan

BLINE_ATM Bootline for ATM interface.

BLINE_ESWITCH Bootline for Eswitch.

USB_PID Product ID of USB device. (16-bit value)

USB_VID Vendor ID of the USB device. (16-bit value)

USB_EPPOLLI USB Endpoint Polling Interval, in milliseconds. This is the polling rate for device interrupts.

USB_SERIAL Serial number of USB device.

REMOTE_USER User Name on the remote system (for FTP)

REMOTE_PASS User password on remote system (for FTP)

REMOTE_DIR Directory on the remote system (for FTP)

LINK_TIMEOUT Time in seconds to wait for the link to come up before starting DHCP.

MAC_PORT The Active MAC port number. Valid values : 0 and 1

PATH The path in FFS to search for application to execute. This variable should consist of directories in FFS separated by ‘:’ Example /bin:/dev/ttyS0. This variable is read at boot time only. If at boot-time this variable is found to be undefined, it takes a default value of “/bin:/dev/ttyS0”

HOSTNAME The hostname for the Target.

TFTPCFG Configure the timeout and retransmission count of TFTP client. The configuration is of the form: **<Time-out (seconds)>: <Retransmissions Count>**

For Example, TFTPCFG value of 6:5 denotes that the timeout is 6 seconds and the retransmissions count is 5. If this variable is not set or not set properly, the default configuration is taken. The default time-out is 5 seconds and the default retransmissions count is 5. Set of valid values for time-out and retransmissions count is positive integers greater than zero. Care should be taken while setting the TFTPCFG variable. It should be set taking into account the timeout and retransmission values at the server side. A mismatch might result in one of the sides waiting for transfer while the other times out.

4.4 Adding Environment Variables

4.4.1 Adding new pre-defined environment variables

The bootloader supports pre-defined environment variables. Every environment is referenced by a unique index, common across the system. This indexing is supported by using the enumerator data type of C.

The file, env.c should be common across PSP bootloader and OS and any other application running on the system. This is since the environment file system is a shared global resource.

Following are the steps for adding a new pre-defined environment variable.

NOTE: Steps 1 and 2 are for adding a new environment of the PSP Bootloader type.

1) Add the environment variable name in the enumeration data type, ENV_VARS, in file env.c. Care should be taken that the new variable name is added to the end of the ENV_VARS, immediately before the enumerator env_vars_end. This allows intact pre-defined environment variables and assigning a new unique value for the added variable.

To use the added environment variable with the APIs sys_setenv(), sys_getenv(), sys_unsetenv(), use the new enumerator name as a string.

2) Add the new environment enumerator name in the array, env_ns, in env.c, using the macro _ENV_ENTRY. This macros provides a lookup for the respective name string for the environment. This entry in the env_ns can be added anywhere and there is no positioning requirement. The last entry in this array should always be _ENV_ENTRY(0).

This support is mainly for the shell support for set and print of environments.

4.4.2 Adding new dynamic environment variables

Addition of dynamic variables is fairly simple. A new dynamic variable can be added by using the setenv command of the bootloader and supplying a variable name and value. Dynamic variables are to be used with caution as they are less space efficient than pre-defined ones. They are meant for ease of use in development stage. Once the system is in deployment stage, it is highly recommended to convert all the finalized environment variables into pre-defined ones.

5 FLASH FILE SYSTEM (FFS)

5.1 API List

5.1.1 ffs_init

Name: ffs_init - Initialize the Flash File System

```
Synopsis:
#include <ffs.h>

int ffs_init(void);
```

Description:
The ffs_init routine is used to initialize the FFS before using it.

Return Value:
This always return with 0, indicating successful operation.

5.1.2 ffs_fopen

Name: ffs_fopen - open a file on FFS

```
Synopsis:
#include <ffs.h>
FFS_FILE  *ffs_fopen(const  char  *filename,  const  char
*type);

   filename: File name to open (string)
   type:     Mode of file operation (string)
```

Description:
The ffs_fopen routine initializes the data structures required for file operations. Two fundamental kinds of access are provided: read and write. `type' must begin with either of "r" or "w", to select either for read or write operation, respectively.

This returns a file pointer for usage on every subsequent reference to the opened file.

Append mode is not supported.

Returns:
Upon successful execution, a file pointer of type FFS_FILE will be returned. On failure, it returns with NULL.

5.1.3 ffs_fread

Name: ffs_fread - read array elements from an FFS file

```
Synopsis:
#include <ffs.h>
```

```
size_t ffs_fread(void *ptr, size_t size, size_t nitems,
FFS_FILE *stream);

   ptr:    Memory pointer, to copy read data to.
   size:   Size of each element to read.
   nitems: Number of elements to read.
   stream:  File pointer, identifying the file to read
           from.
```

Description:
`ffs_fread' reads `nitems' number of elements, each of size `size', to the memory pointed to by `stream'. `ffs_fread' may copy fewer elements than `nitems' if an error, or end of file occurs. `ffs_fread' also advances the file position indicator in it's FCB by the actual number of elements read.

Returns:
It returns the number of elements read. Upon error or EOF, it returns 0, indicating zero elements read.

5.1.4 ffs_fwrite

Name: `ffs_fwrite` - write array elements to an FFS file

```
Synopsis:
#include <ffs.h>
size_t
ffs_fwrite(const void *ptr, size_t size, size_t nitems,
FFS_FILE *stream);

   ptr:    Memory pointer, to copy data from.
   size:   Size of each element for write.
   nitems: Number of elements to write.
   stream:  File pointer, identifying the file to write
           to.
```

Description:
`ffs_fwrite' attempts to copy `nitems' number of elements, each of size `size', starting from memory location `ptr' to the file, `stream'. `ffs_fwrite' may write fewer elements than requested if an error occurs. `ffs_fwrite' will also advance the file position indicator in it's FCB by the actual number of elements written.

Returns:
Number of elements written. On an error, it returns 0.

5.1.5 ffs_fseek

Name: `ffs_fseek` - set file position

```
Synopsis:
#include <ffs.h>
```

```
int   ffs_fseek(FFS_FILE   *stream,   bit32   offset,   int
ptrname);

    stream:  FFS file pointer.
    offset:  New position offset.
    ptrname: Mode of `offset' usage.
```

Description:
`ffs_fseek' sets the file position indicator in it's FCB, defined by `offset'. The different referencing modes are:

FFS_SEEK_SET: `offset' is the absolute file position desireable.
FFS_SEEK_CUR: `offset' is relative to the current file position.
FFS_SEEK_END: `offset' is relative to the current end of file. `offset' can be either positive or negative.

Returns:
Upon successful operation, it returns 0. On failure, it returns EOF.

5.1.6 ffs_fclose

Name: ffs_fclose - close a file

Synopsis:

```
#include <ffs.h>
int ffs_fclose(FFS_FILE *stream);

    stream: FFS file pointer.
```

Description:
`ffs_fclose' closes an FFS file `stream' if already open, after ensuring that any pending data is returned.

Returns:
When successful, it returns 0. Otherwise, it returns EOF.

5.1.7 ffs_remove

Name: ffs_remove - delete an FFS file

Synopsis:

```
#include <ffs.h>
int ffs_remove(const char *filename);

    filename: File to be removed (string)
```

Description:
`ffs_remove' deletes a file from the FFS file system. Following a remove, the file will no longer be accessible.

Returns:

On success, it returns 0. Else, it returns -1.

6 ENVIRONMENT AND FFS SUPPORT FOR OPERATING SYSTEMs

Since PSPBoot is meant to cater to various Operating Systems (like VxWorks, Linux and WinCE), a set of files for the environment variables and flash file system, will be provided which require to be pulled in and compiled with the respective compiler suite of the particular OS.

Here is the list of files to be compiled in for Environment and FFS support. These files can be soft-linked into the OS VoB from the `psp_boot` VoB. psp_boot VoB will contain a directory named '`export`' which will contain links (within '`psp_boot`' VoB) to files required to be compiled in the OS kernel for environment and FFS support. The directory '`inc`' within the '`export`' directory contains the header files containing the interfaces for environment and FFS access.

File Name	Required to Support
inc\psbl\debug.h	ENV and FFS
psbl\kernel\env.c	ENV
inc\psbl\env.h	ENV
inc\psbl\errno.h	ENV and FFS
inc\psbl\flashop.h	ENV and FFS
psbl\kernel\flashop_xx.c [Board dependent]	ENV and FFS
inc\psbl\hw.h	ENV and FFS
platform.h [To be provided by the OS]	ENV and FFS
Platform.c [To be provided by the OS]	ENV and FFS
Psbl\kernel\shell.h	ENV and FFS
inc\psbl\stddef.h	ENV and FFS
inc\psbl\sysconf.h	ENV and FFS
Psbl\kernel\fcb.c	FFS
Psbl\kernel\ffs.c	FFS
Psbl\kernel\ffs_extra.c	FFS
Psbl\kernel\ffs_extra.h	FFS
Psbl\kernel\fcb.h	FFS
inc\psbl\mod.h	FFS
inc\psbl\ffs.h	FFS
inc\psbl\stdio.h	FFS

These files should be included in the OS sources and compiled into the OS kernel.
For initializing the Environment support, `sys_initenv()` should be called.
This call should be made before Environment/Flash File System support is used.

The file `env.c` has an external dependency on the OS to provide it with mutual exclusion primitives for serializing Flash access (Read or Write). The functions `int enter_critical_section()` and `int exit_critical_section()` should be defined by the OS (preferably in `platform.c`). These primitives when defined, will ensure that there is only a single process reading or writing to the flash at any point of time. Please note that this support is available only for Environment variables and not for flash

file system. If such a (mutual exclusion) facility is not required, then these routines can be defined to be empty routines.

The file `platform.h` is used to provide any OS dependent defines for compiling the PSPBoot files. For Example, for VxWorks, platform.h should define sys_printf (print function in PSPBoot) to printf. (print function in vxWorks) .
The files `platform.c` and `platform.h` will not be provided in PSPBoot VoB and will have to be maintained along with the OS sources.

Care should be taken **not** to define the macro _STANDALONE while compiling the bootloader sources. This macro is defined only when compiling PSPBoot and is used in the code to decide the context. (OS or bootloader).

Also note that it is not mandatory to use both the environment and FFS support together. For example, Linux currently uses only environment support and not FFS support.

7 DHCP SUPPORT

PSPBoot has DHCP client support that is used to get the system IP address, subnet mask, gateway address (router), boot-file name and the TFTP server IP address.

DHCP support is enabled using the BOOTCFG environment variable. For more details on enabling DHCP using the BOOTCFG environment variable please look at documentation on BOOTCFG in the description of `'boot'` command.

The DHCP client sends a broadcast request to the DHCP server(s) in the same subnet requesting IP address, gateway IP address, boot-file name and TFTP server name. The DHCP server must be configured correctly to provide this information to the DHCP client.

If the boot configuration (using BOOTCFG) requires that the boot-file be downloaded from network, DHCP server must provide the correct "boot-file name" as well as the "next server IP address" else the OS boot will fail. If DHCP server provides the "next server IP address" as 0.0.0.0 then IPA_SVR is not set and this configuration is ignored. Similarly, "boot-file name" of NULL value is ignored. In such cases, the DHCP server's configuration should be reviewed.

The "Vendor class identifier" sent by the DHCP client in PSPBoot 1.1 is "TI-dhcp 0.1".
The hostname sent by the target during the DHCP process is taken from the environment variable HOSTNAME. If HOSTNAME variable is not present, a default value (value depending on the board for which PSPBoot is compiled) is sent.

DHCP request is sent out only when a reboot is done. The environment variable LINK_TIMEOUT is used to specify the time in seconds to wait for the link to come-up before starting the DHCP process.

`References:`

RFC 2131
RFC 2132

8 BOOTLOADER CUSTOMIZATION

8.1 Application Support: Extending Bootloader Functionality.

8.1.1 Introduction

A PSPBoot application is an independent program written to be executed in PSPBoot context. Applications are mainly used to extend the functionality of PSPBoot. Applications are developed and built using the application framework provided by PSPBoot. The application framework consists of defining the memory map for the application, creation of C-Runtime environment for application execution and a makefile for compiling the applications.

8.1.2 Application interface to PSPBoot

PSPBoot provides a number of pre-defined entry points into the bootloader to the applications. These entry points enable the application to use a number of bootloader features. It also reduces the size of the applications by reuse of routines that already exist in the bootloader context. These entry points are termed as SRRs (System Resident Routines). The application is compiled along with a library of SRRs `(libsrr.a)` that helps the application jump to the appropriate location whenever an SRR is invoked. Thus SRRs can be invoked just like any normal function. The linkage to bootloader context is taken care by the application framework through the SRR Library. The list of currently supported SRRs can be found in the file `inc\apps\srr.h` in the source tree

8.1.3 Writing applications for PSPBoot

The sources for all the applications written for PSPBoot should be kept in `apps\src` directory. The Application will start executing at a function called `mymain`. This function is a must for all applications. A template application is provided in the file `apps\src\template.c.` This file can be taken as a starting point for all new applications.

8.1.4 Compiling applications for PSPBoot

To compile an application spanning only one C source file, the source file name should be added to the `APPS_SRCS_C` list in `apps\makefile`. For example, if the source file is `app.c`, the application can be complied by issuing the command: `make app.`

To compile an application spanning multiple C/Assembly source files, a new rule should be created which will compile all the C and Assembly files related to the application. Also, this rule should be added as a dependency for the `'all'` rule. To build all the applications supported, use make all.

8.1.5 Sample applications

The following sample applications are provided.

8.1.5.1 im: inspect memory

This application is used to read and modify memory

```
Usage: im [-b | -h | -w]  [Hexadecimal Address]
```

This application takes an optional hexadecimal address and displays the contents of that memory location. If no address is provided the inspection starts at `0xb400'0000`. The application advances to next address when return key is pressed. Pressing the `'-'` key goes to the previous address. To exit the application, `'.'` key should be pressed.

`[-b]` Inspect memory byte-wise.
`[-h]` Inspect memory half-word wise.
`[-w]` Inspect memory word wise. (default)

8.1.5.2 update: update bootloader using TFTP.

This application is used to update the bootloader using TFTP.

```
Usage: update  [-est] <bootfile-name>
```

This application takes a bootfile and burns it at 0xb000'0000 (start of flash) after downloading it through TFTP. The bootfile should be a flat binary file for flash download. If the bootfile being downloaded is a flat binary image obtained through the VisionClick™ `"convert"` utility, `-est` should be used to indicate this.

8.1.5.3 defrag: de-fragment the Flash File System.

This application is used to de-fragment the Flash File System. De-fragmentation of the Flash File System physically frees up the space used by the deleted files in the FFS.

```
Usage: defrag  [-h | -r | -v]
```

`[-h]` Prints help information and quit.
`[-r]` Just report the amount of space that can be freed and quit.
`[-v]` Run the tool in verbose mode

8.2 Flash Memory Manager: Allocating Sections in Flash

Flash Memory manager (FMM) is designed to facilitate easy and optimum use of flash.

Certain Intel and AMD flash types have 'Tiny' blocks built into them. The 'Tiny' blocks are small blocks – typically 4K or 8K or 16K in size – that are present so that wastage of space in a large segment due to storage limitations of flash can be avoided.
These tiny blocks are typically used to store system environment variable, configuration data etc.

In PSPBoot1.1, all the allocation of flash memory – including that for Environment Variables, Flash File System and the bootloader itself – is done through the Flash Memory manager.

The FMM module mainly exposes two interfaces:

`FMMSetSectionInfo:` This interface is used to allocate a section in flash at a specified location in flash, overriding the Flash memory manager's allocation algorithm. For example, bootloader is always allocated a section at the base of flash irrespective of the tiny block position using this API.

`FMMAllocateSection:` This interface is used to allocate a section in flash based on Flash Memory manager's allocation algorithm. Flash memory manager always allocates the 'tiny blocks' first. Hence if a section (like environment space) has to be allocated 'tiny blocks' on a higher priority over another section (like FFS), it should be allocated space first.
To get the minimum block allocated, a size of 1 byte can be specified. To get all the currently free space allocated, a size equal to size of Flash can be requested.

Each section is identified by a unique string literal (tag). The tags for the bootloader, Environment space and FFS are fixed and should not be changed. Users are free to use their own tags (max length 10) for the user defines sections.

The allocation of all sections takes place under a single API `FMMConfigSections` in file `fmm.c`. Allocation of new sections should be done under this function.

8.3 BU specific Hooks

The following hooks are provided for BUs to add their own code at various points if initialization/execution.

1. void psbl_asmhook_init1 (void)

This is an assembly hook function that gets called immediately after the processor initialization. The SoC is not yet initialized. A sample usage of this hook is similar to the usage with TNETD7300 where the power comparator requires to be turned on as early as possible in the bring-up process to save the board from any rapid power fluctuations.

2. void psbl_asmhook_init2 (void)

This is an assembly hook function that gets called after the SoC initialization. At this stage, the processor and SoC is initialized and basic POST is executed successfully. Functionalities like extended POST, SOC workarounds and some hardware bug fixes can be performed here.

3. **void psbl_chook_init3 (void)**

This hook is present at the same stage as `psbl_asmhook_init2` but allows the hook to be written in C language.

4. **void psbl_chook_init4 (void)**

This is a C function that will be called after the system is brought up and before executing the shell engine. At this stage, the whole of the system is up, with environment variables configured with the board specific information, serial driver/network drivers installed, and CPU/System frequencies configured. Any functionality that can be executed via a command can be installed here.

5. **void psbl_chook_poll (void)**

This is a C fun ction that will be called periodically when the shell engine is running. This hook can be used, for example, to periodically poll the status of any device/module and execute, if any, and call a user defined function under any given condition.

8.4 EMIF configuration

EMIF configuration for PSPBoot can be done in a flexible manner for AR7, TNETV1050 and TNETV1020 platforms.
The file `inc/emif.h` includes a board specific include file. The board specific file contains set of definitions for different parameters for SDRAM and Asynchronous banks of the SoC. These definitions can be changed to suit any particular modifications in EMIF settings that may be required.

8.5 Miscellaneous Customizations

8.5.1 Secondary Flash Support

PSPBoot has the capability to support two discontinuous (referred to as primary and secondary) flash devices. The Flash File System is implemented to show both the devices as a single unit. Use the Makefile (`\psp_boot\Makefile`) option `-DDUAL_FLASH` to enable this support.

Notes:
1. PSPBoot requires the definition of SEC_FLASH_BASE when Dual Flash option is chosen. This definition has to be according to where the secondary flash resides. The primary flash is always assumed to start at CS0
2. PSPBoot assumes that both the flash devices are of same type. That is, the same flash driver can operate on both the devices.
3. PSPBoot assumes that the flash driver is aware of the existence of the secondary flash device.

9 KNOWN LIMITATIONS

- The PSP Bootloader depends on `sead1.exe` on host machine for serial download.
- The ftp command should not be used with FFS installed.
- PC application is supported only in Little Endian mode.

For a full set of known limitations for a particular release, please refer to the Release Notes of that release.