Application Report

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DSP/BIOS Sizing Guidelines for TMS320C2000/C5000/C6000 DSPs

Arnie Reynoso *SDO Applications*

ABSTRACT

The DSP/BIOS real-time kernel is a scalable library that allows application developers to control how much of the real-time operating system is actually placed in target memory and to optimize the tradeoff between memory usage and functionality.

This application report contains information on the size impact of using DSP/BIOS modules in your application, as well as a number of hints and guidelines to help you optimize your application's use of memory. It highlights different aspects of the DSP/BIOS library that are under your control and that impact the overall memory usage of the DSP/BIOS kernel.

As a DSP/BIOS user, you should be aware that it may be appropriate to change the way your application is configured over the life of the project. For example, host/target communication can be crucial during product development but may not be necessary when the application is deployed, allowing a reduction in the final overhead size. To that end, some hints given in this application report may not be applicable now, but may be relevant later.

Contents

1 DSP/BIOS Configuration Tool

Because DSPs are used in such a wide range of applications—from small battery operated devices to large multiprocessing systems—any general-purpose system software for DSPs must be extremely flexible in both functionality and size.

The DSP/BIOS kernel is a run-time library that provides a wide range of real-time kernel services broken up into different modules. Each of these modules can be linked in by a DSP application or left out entirely. The key to this is DSP/BIOS's configuration capability. DSP/BIOS can be configured graphically or textually (using Tconf). Both work well inside Code Composer Studio. You can statically (that is, prior to run time) configure an application to link in only the services it actually needs. In this way, you can manage a memory-constrained application's tradeoff between the functionality available through DSP/BIOS and the overall memory footprint of the application. The Configuration Tool allows you to configure different aspects of a particular module so that it is optimized to work within the application. Therefore, the general-use DSP/BIOS kernel can be transformed into an application-specific, run-time environment.

The tradeoffs between different DSP/BIOS modules and their impact on system memory can be complex because applying a module usually requires support of other modules. For example, the MBX module depends on (and therefore links in) the code from the SEM and QUE modules.

It is also important to realize that, even if a module's code is linked in, it does not necessarily link in the entire module, but typically only the functions referenced by the application—an optimization that keeps the overall size impact of the DSP/BIOS kernel to a minimum.

Because of the complexity of these tradeoffs, it is important to understand that this application report does not set up an analytical model of estimating DSP/BIOS overhead, but rather gives some sizing scenarios based on a default configuration or a base configuration.

2 Creating a Minimal Footprint DSP/BIOS Application

This section contains hints on how to use the Configuration Tool to lower the overhead of the DSP/BIOS kernel. The actual size reduction of using these techniques depends on the specific application's configuration.

2.1 Default Configuration

Unlike previous versions, the 5.xx version of DSP/BIOS provides a simple way to create a new configuration with minimal features enabled (that is, with Dynamic Memory Heaps, Real-Time Analysis, RTDX, and TSK Manager disabled). Even with all these features disabled, there are a few additional techniques that can be applied to further minimize DSP/BIOS code size usage.

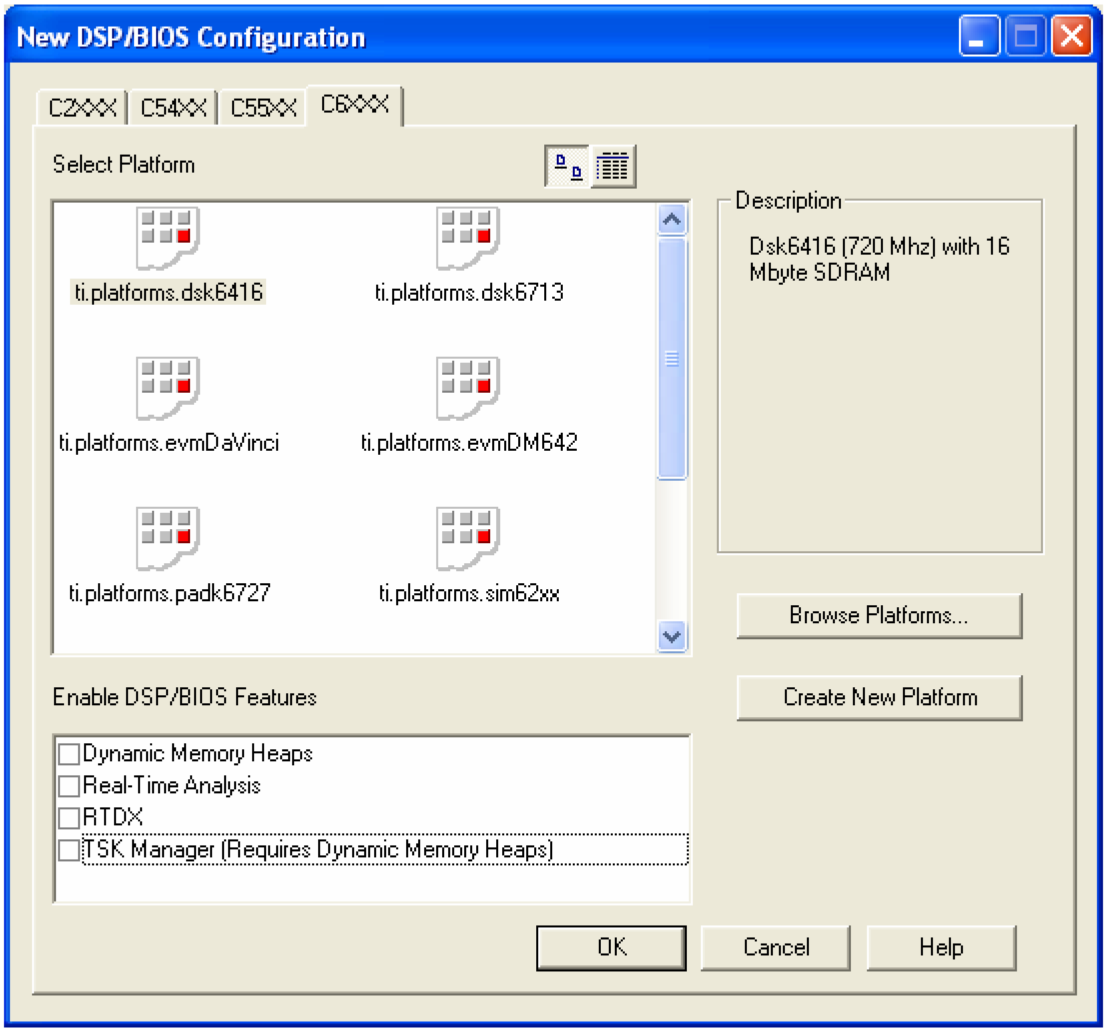
The starting default configuration still includes message logging for execution tracking (LOG), built-in statistics gathering (STS), timer configuration and usage (CLK), interrupt vector handling (HWI), and basic system services (SYS) for halting and printing program execution.

All the values shown for the default configurations include code and data footprint sizing for the entire application. The application contains an empty main() function. The data values include the necessary C-initialized (.cinit) and uninitialized records (.bss) used by the application.

The default DSP/BIOS configuration file (*.tcf) calls the utils.loadPlatform() and the prog.gen() to generate the appropriate files as shown below:

```
utils.loadPlatform("ti.platforms.dsk6416");

// !GRAPHICAL_CONFIG_TOOL_SCRIPT_INSERT_POINT!
if (config.hasReportedError == false) {
    prog.gen();
}
```

To create a default configuration yourself, you can use a similar script (as shown above) or have one created for you. To have one created in CCStudio, choose File->New->DSP/BIOS Configuration, select the platform you'd like to start from, and disable (un-check) features under the Enable DSP/BIOS Features as shown in the following figure:



Dsk6416 (720 Mhz) with 16 Mbyte SDRAM

☐ Dynamic Memory Heaps
☐ Real-Time Analysis
☐ RTDX
☐ TSK Manager (Requires Dynamic Memory Heaps)

The DSP/BIOS features you disable have the following functionality:

- **Dynamic Memory Heaps.** The DSP/BIOS kernel allows applications to dynamically allocate objects and storage areas in a heap area using the XXX_create() functions and the MEM_alloc(), MEM_calloc() and MEM_valloc() functions. Removing this functionality from the kernel allows the linker to remove the XXX_create functions and the MEM module code from the executable. The linker does not set up a memory heap area.

- **Real-Time Analysis.** The DSP/BIOS kernel provides the ability to extract real-time analysis (RTA) data from running applications. In this way, you can get visibility into performance, as well as insight into how the application runs on a per-thread and ISR basis. RTA data is extracted implicitly from a version of the DSP/BIOS library instrumented for this purpose and explicitly by developers who embed API calls in the application. The data is sent to the PC host when the RTA plug-ins running in CCStudio on the PC poll the target. This is done through background IDL threads that have the lowest priority in the DSP system. Although real-time analysis can be valuable (or even critical) during software development, it impacts the overall memory requirements to accommodate the instrumented DSP/BIOS library, as well as the RTA APIs and the host/target communication infrastructure.

- **RTDX.** The DSP/BIOS kernel includes Real-Time Data Exchange (RTDX) functionality. RTDX provides a mechanism for applications to move data between the DSP and host PC, without stopping the DSP and incurring only a minimal amount of intrusion. The RTDX library uses a scan-based emulator to move data via the JTAG interface.

- **TSK Manager.** The DSP/BIOS TSK manager allows applications to create and manipulate independent threads of control. Many DSP/BIOS applications may not take advantage of this at all, in favor of implementing run-to-completion threads using software interrupts (SWIs) or just implementing a single-threaded control loop. Disabling the TSK manager conserves system memory by eliminating unneeded DSP/BIOS code, as well as eliminating the need for a task stack to be allocated.

2.2 Base Configuration

Defining what constitutes a base DSP/BIOS setup is somewhat arbitrary. For the purpose of this document, a base configuration contains various techniques to minimize footprint of DSP/BIOS applications. The following Tconf configuration script illustrates the base setup as an example:

```
utils.loadPlatform("ti.platforms.dsk6416");

/* Setting system stack size to 1k 8-bit bytes */
bios.MEM.STACKSIZE = 0x0400;

/* Disabling PRD and CLK */
bios.PRD.USECLK = 0;
bios.CLK.ENABLECLK = 0;

/* Disable the DSP/BIOS instrumented library */
bios.GBL.INSTRUMENTED = 0;
bios.GBL.ENABLEALLTRC = 0;

/* Removing SYS Handle functions */
bios.SYS.TRACESIZE = 0;
bios.SYS.ABORTFXN = prog.extern("UTL_halt");
bios.SYS.ERRORFXN = prog.extern("UTL_halt");
bios.SYS.EXITFXN =  prog.extern("UTL_halt");
bios.SYS.PUTCFXN =  prog.extern("FXN_F_nop");

/* Reducing the System LOG buffer */
bios.LOG_system.bufLen = 0;

// !GRAPHICAL_CONFIG_TOOL_SCRIPT_INSERT_POINT!

if (config.hasReportedError == false) {
    prog.gen();
}
```

The following subsections describe in detail each of the above statements in the configuration script. The base configuration, as in the default case, doesn't make any DSP/BIOS API calls and contains an empty main() function only.

NOTE: Values for the system stack are configured to 1 K 8-bit bytes for C6000 platforms and 512 16-bit words on all other platforms. This maintains consistency across ISAs (instruction set architectures). On ‘C55x, the system stack and the stack both total 512 16-bit words.

2.2.1 Disabling CLK and PRD

The CLK module allows an application to invoke functions on a periodic basis. This module provides a real-time clock, and can be used in conjunction with the Real Time Analysis (RTA) tools to measure periods of time or to add a timestamp to event logs.

The Periodic module (PRD) allows periodic execution of program functions based on the CLK module. By default PRD is driven by a CLK instance. All PRDs run in the context of PRD_swi, which is, itself, a software interrupt (SWI).

By disabling the use of CLK to drive the PRD, the CLK object used by the PRD (PRD_clock) is removed. The SWI object is also removed when no PRD objects are configured.

If no other objects are dependent on CLK, the module can also be disabled. This brings significant savings since neither the SWI nor the CLK module are linked in (if no other SWIs are used). The following configuration statements were added to the default configuration for the base configuration:

```
bios.PRD.USECLK = 0;  // remove dependency of PRD on CLK so CLK can be disabled
bios.CLK.ENABLECLK = 0;
```

Note that the TSK manager, when enabled, uses PRD to drive TSK ticks. The TSK ticks are responsible for advancing the system alarm clock to ready any TSK whose timeout interval has expired (for example, via TSK_sleep or SEM_pend). If the CLK module is not used to advance the system clock, the application may call TSK_tick to advance the system clock.

2.2.2 Disabling the DSP/BIOS Instrumented Library

The DSP/BIOS kernel instruments a few modules (TSK, SEM) to gather additional statistical information that can be seen with the CCStudio DSP/BIOS tools (DSP/BIOS -> Statistics View). By leveraging the non-instrumented DSP/BIOS library, code savings can be obtained in the case where the TSK or SEM module is being used.

Tracing by the TRC module is also disabled since RTA is not being used. This disables RTA tracing when the application is loaded. Tracing can be re-enabled through the RTA Control Panel in CCStudio or by calling TRC_enable in the application.

The following configuration statements were added to the default configuration for the base configuration:

```
bios.GBL.INSTRUMENTED = 0;   // Disable the instrumented kernel library
bios.GBL.ENABLEALLTRC = 0;   // Disable the TRC mask
```

NOTE: The footprint savings, when disabling the use of the DSP/BIOS instrumented library, is seen only when the TSK and SEM modules are being used in the application. Otherwise, either library has the same footprint impact. When using the non-instrumented version of the library, the generated DSP/BIOS linker command file (*cfg.cmd) contains a reference to the bios_NONINST.a## instead of the bios.a## (## values are architecture dependent).

2.2.3 Removing SYS Handling Functions

The SYS module provides a set of basic system services such as halting program execution and printing formatted text. The SYS module is used by other DSP/BIOS modules in lieu of similar C library functions. The SYS module default handlers use DSP/BIOS UTL functions to perform these tasks.

Users can set their own functions for the SYS module to call. In this way, developers can control what handler functions are called by specifying their own custom handler functions, or specifying a smaller function such as the DSP/BIOS UTL_halt function.

The Configuration Tool controls the handler functions for the following SYS module functions:

- SYS_exit(), which is used for orderly program terminations.
- SYS_abort(), which is used to terminate the program from a catastrophic situation.
- SYS_error(), which is used to handle kernel and application error conditions.
- SYS_printf(), SYS_sprintf(), SYS_vprintf() and SYS_vsprintf(), which are used to output formatted data.

The DSP/BIOS kernel uses the SYS_error() function in the modules' XXX_create() functions, in the MEM module functions, and by the SIO stream input and output manager, so an application taking advantage of these services should have some kind of SYS_error() handler in place.

Like all other functions, the SYS_printf() family of functions is linked into an application only if any of them are used. We recommend that applications avoid using the SYS_printf() family of functions entirely in favor of the LOG_printf() function, which is several orders of magnitude more efficient in terms of both memory usage and CPU cycles.

The following script lines were added to the default configuration to reduce the base configuration footprint:

```
bios.SYS.TRACESIZE = 0;                      // Reduce SYS buffer size to 0 (zero)
bios.SYS.ABORTFXN = prog.extern("UTL_halt"); // Set SYS functions to UTL_halt
bios.SYS.ERRORFXN = prog.extern("UTL_halt");
bios.SYS.EXITFXN =  prog.extern("UTL_halt");
bios.SYS.PUTCFXN =  prog.extern("FXN_F_nop");// Set the SYS putC function to a NOP
```

2.2.4 Reducing the System LOG Buffer

The LOG module is used by the DSP/BIOS system to log system execution information. The default configuration sets the LOG buffer size to 64 (words) of the LOG_system object. User LOG instances also default to 64 words (or 16 LOG records). Though LOG_system can't be removed, the size of the LOG buffer can be modified. The following script line was added to reduce to LOG buffer size to zero (0).

```
bios.LOG_system.bufLen = 0;    // Set system LOG buffer to zero (0)
```

NOTE: Reducing the LOG_system buffer size provides only data savings. There is no code savings.

3 Module Sizing Applications

The applications described here are used to measure the sizing impact of adding various modules. The applications build upon each other. This means that the configuration modification and DSP/BIOS API calls used in one section are subsequently used in the following sections, unless otherwise specified.

The BIOS_INSTALL_DIR\packages\ti\bios\benchmarks\html\Results.html file in the 5.30 or greater DSP/BIOS release distribution contains links to HTML files that contain size information for the following applications on all supported platforms. All the values in the result tables are in 8-bit bytes. Though some platforms don't support 8-bit byte access, the values are displayed in this format to maintain consistency across architectures.

3.1 Base Application

This is the starting point for our measurements. The configuration used here is identical to the base configuration described in Section 2.2.

3.2 HWI Application

In the HWI application, support for the HWI dispatcher has been added. Enabling the dispatcher allows the application to call an Interrupt Service Routine (ISR) without needing to call other functions to save the register values during context switching. (ISR functions can be written in C.) Using the HWI dispatcher creates a one time code/data impact on the application. The dispatcher is enabled on a per-interrupt basis from the individual HWI property pages. The HWI Dispatcher is automatically linked into the application if RTDX is enabled or a CLK object is created.

To the base configuration script, the following has been added:

```
bios.HWI.instance("HWI_INT8").useDispatcher = 1;
bios.HWI.instance("HWI_INT8").fxn = prog.extern("FXN_F_nop"); // Call to a NOP function
```

For the ‘C54x platform the following script lines were used:

```
bios.HWI.instance("HWI_SINT4").useDispatcher = 1;
bios.HWI.instance("HWI_SINT4").fxn = prog.extern("FXN_F_nop");
```

The application also makes a call to the following DSP/BIOS API:

- HWI_dispatchPlug()

3.3 CLK Application

In the CLK application, the CLK manager is enabled and a CLK object has been added to the HWI application configuration. The CLK module is processor-dependent; therefore overhead values vary slightly between processors. The following configuration script lines were added:

```
bios.CLK.ENABLECLK = 1;
bios.CLK.create("CLK0");
```

The application also makes a call to the following DSP/BIOS API:

- CLK_gethtime()

3.4 CLK Object Application

In the CLK object application, an additional CLK object has been created to illustrate the size impact of each CLK object. The following configuration script line was added to CLK application:

```
bios.CLK.create("CLK1");
```

3.5 SWI Application

In the SWI application, a single SWI object has been added to the CLK object application configuration. The following configuration script lines were added:

```
bios.SWI.create("SWI1");
bios.SWI.instance("SWI1").priority = 1;
```

The application also makes a call to the following DSP/BIOS API:

- SWI_post()

3.6 SWI Object Application

In the SWI object application, an additional SWI object has been created to illustrate the size impact of each SWI object. The following configuration script lines were added to SWI application:

```
bios.SWI.create("SWI2");
bios.SWI.instance("SWI2").priority = 1;
```

3.7 PRD Application

In the PRD application, the PRD module was enabled to use the CLK module. A PRD object has also been added to the SWI object application configuration. The following configuration script lines were added:

```
bios.PRD.USECLK = 1;
bios.PRD.create("PRD0");
```

Note: If a function executes at the frequency of the timer interrupt, it may be more efficient to create a CLK object to run the function rather than a PRD object. The reason for this is that CLK objects are implemented to run off the timer's hardware interrupt, while PRD objects are implemented as software interrupts (SWI). The caveat to this is that PRD objects cannot be replaced with CLK objects in all circumstances—for example, when the execution time of the function being called is long (that is, greater than or equal to half the timer interrupt rate).

The application also makes a call to the following DSP/BIOS API:

- PRD_getticks()

3.8 PRD Object Application

In the PRD object application, an additional PRD object has been created to illustrate the size impact of each PRD object. The following configuration script line was added to PRD application:

```
bios.PRD.create("PRD1");
```

3.9 TSK Application

In the TSK application, the TSK module was enabled and a TSK object has been added to the PRD object application configuration. Enabling the TSK module creates an IDL task object. All TSK objects created statically in this application are set to a stack size of 512 bytes. (Though some platforms don't support 8-bit byte access, the application is configured accordingly to maintain size consistency across architectures.) The TSK stack sizes for each TSK can be adjusted accordingly (see the TSK Module section in the *DSP/BIOS API Reference* for more information). The following configuration script lines were added:

```
bios.TSK.ENABLETSK = 1; // Enable the TSK module

/*  Set TSK stacks of 512 (8-bit) bytes */
bios.TSK.instance("TSK_idle").stackSize = 0x100; // config is in (16-bit) words

bios.TSK.create("TSK0");
bios.TSK.instance("TSK0").stackSize = 0x100; // config is in (16-bit) words
```

For ‘C6000 platforms, the following script lines were used:

```
bios.TSK.ENABLETSK = 1; // Enable the TSK module

/*  Set TSK stacks of 512 (8-bit) bytes */
bios.TSK.instance("TSK_idle").stackSize = 0x200; // config is in (8-bit) bytes

bios.TSK.create("TSK0");
bios.TSK.instance("TSK0").stackSize = 0x200; // config is in (8-bit) bytes
```

For ‘C55x platforms the following script lines were used:

```
bios.TSK.ENABLETSK = 1; // Enable the TSK module

/* Set sum of TSK stack and sysstack sizes to 512 (8-bit bytes) */

bios.TSK.instance("TSK_idle").stackSize = 0x0c0;    // config is in (16-bit) words
bios.TSK.instance("TSK_idle").sysStackSize = 0x040; //config is in (16-bit) words

bios.TSK.create("TSK0");
bios.TSK.instance("TSK0").stackSize = 0x0c0;    //config is in (16-bit) words
bios.TSK.instance("TSK0").sysStackSize = 0x040; //config is in (16-bit) words
```

The application also makes a call to the following DSP/BIOS API:

- TSK_yield()

3.10 TSK Object Application

In the TSK object application, an additional TSK object has been created to illustrate the size impact of each TSK object. The following configuration script lines were added to the TSK application:

```
/*  Set TSK stack of 512 (8-bit) bytes */
bios.TSK.create("TSK1");
bios.TSK.instance("TSK1").stackSize = 0x100; // config is in (16-bit) words
```

For C6000 platforms, the following script lines were used:

```
/*  Set TSK stack of 512 (8-bit) bytes */
bios.TSK.create("TSK1");
bios.TSK.instance("TSK1").stackSize = 0x200; // config is in (8-bit) bytes
```

For ‘C55x platforms, the following script lines were used:

```
/* Set sum of TSK stack and sysstack sizes to 512 (8-bit bytes) */
bios.TSK.create("TSK1");
bios.TSK.instance("TSK1").stackSize = 0x0c0;    //config is in (16-bit) words
bios.TSK.instance("TSK1").sysStackSize = 0x040; //config is in (16-bit) words
```

3.11 SEM Application

In the SEM application, a SEM object has been added to the TSK object application configuration. The following configuration script line was added:

```
bios.SEM.create("SEM0");
```

The application also makes a call to the following DSP/BIOS APIs:

- SEM_post()
- SEM_pend()

3.12 SEM Object Application

In the SEM object application, an additional SEM object has been created to illustrate the size impact of each SEM object. The following configuration script line was added to SEM application:

```
bios.SEM.create("SEM1");
```

3.13 MEM Application

In the MEM application, the configuration is enabled to use memory heaps and a heap of 4 KB was added to the SEM object application configuration. (Though some platforms don't support 8-bit byte access, the application is configured accordingly to maintain size consistency across architectures.) The following configuration script lines were added:

```
bios.MEM.NOMEMORYHEAPS = 0;                    //Enable Memory Heap usage

bios.MEM.instance("IRAM").createHeap = 1;      // Create a Memory Heap in IRAM
bios.MEM.instance("IRAM").heapSize = 0x1000;   // Set size of Memory Heap

bios.MEM.BIOSOBJSEG = prog.get("IRAM");        // Set BIOS Objects to IRAM heap
bios.MEM.MALLOCSEG = prog.get("IRAM");         // Set malloc/free to IRAM heap

bios.TSK.STACKSEG = prog.get("IRAM");          // Set dynamic TSK stacks to IRAM heap
```

For ‘C54x, ‘C55x, and ‘C28x, the heap values in the configuration file are specified in 16-bit words as follows:

```
bios.MEM.instance("DARAM").heapSize = 0x0800;  // Values are in 16-bit words
```

The application also makes a call to the following DSP/BIOS APIs:

- MEM_alloc()
- MEM_free()

3.14 Dynamic TSK application

In the dynamic TSK application, DSP/BIOS run-time APIs create and delete a TSK. Creating a TSK dynamically (that is, at run-time) doesn’t require any changes to the configuration; it uses the same configuration as the MEM application. The only dependency, when using dynamically-created objects, is that a heap must be configured in order to successfully create the TSK object. The application makes a call to the following DSP/BIOS APIs:

- TSK_create()
- TSK_delete()

NOTE: Using the Configuration Tool to create static objects at design-time rather than dynamic objects at run-time allows the application to forego linking in the object creation and deletion APIs, and will also save the overhead of embedding these calls in your initialization and termination routines.

3.15 Dynamic SEM application

In the dynamic SEM application, DSP/BIOS run-time APIs are called to create and delete a SEM. As with the dynamic TSK application, no changes were required to the configuration. The application used the dynamic TSK application configuration and makes an additional call to the following DSP/BIOS APIs:

- SEM_create()
- SEM_delete()

3.16 RTA Application

In the RTA application, all real-time analysis features are enabled, including the use of RTDX and the DSP/BIOS instrumented kernel library. The system LOG buffer size is set to 1 KB. The following configuration script lines were added to the MEM application configuration:

```
bios.GBL.ENABLEINST = 1;         // Enable Real-time Analysis
bios.GBL.INSTRUMENTED = 1;       // Enable the use of the BIOS instrumented kernel
bios.GBL.ENABLEALLTRC = 1;       // Enable all TRC mask logging

bios.enableRtdx(prog);           // Built-in function to enable RTDX if available on
                                 // the platform

bios.LOG_system.bufLen = 1024;   // Set system LOG buffer to 1k
```

4 Module Dependency Table

The table below shows the module dependencies for each of the previously described applications.

Table 1. Module Dependencies

Module/Instance	Dependent Modules	Note
HWI application	HWI, SWI	SWI is used when HWI dispatcher is enabled. One time code and data impact when using the HWI dispatcher.
CLK & CLK Object application	HWI, SWI	CLK size is processor-dependent (values may vary by processor). CLK objects require the use of the HWI dispatcher.
SWI & SWI Object Application	STS	STS is used in SWI statistics gathering.
PRD Application	SWI, STS, CLK (depends on configuration)	PRD uses the CLK module by default (may be changed in the configuration). STS is used in PRD for statistics gathering.
TSK & TSK Object Application	SWI, STS (not used if non-instrumented kernel is selected), SEM (if TSK_sleep is called)	Enabling module creates a TSK_idle function. TSK_idle stack is set to 512 bytes. TSK stacks are set to 512 bytes.
SEM & SEM Object Application	QUE	
MEM Application	None	Requires a heap.
Dynamic TSK application	MEM	Requires a MEM heap to create the object.
Dynamic SEM application	MEM	Requires a MEM heap to create to object.
RTA Application	None	

5 Measuring DSP/BIOS Footprint for Custom Applications

This section explains how we measured the footprint of the sample applications described in Section 3 using a suite of automated tools.

5.1 Using the Linker Map or XML Listing

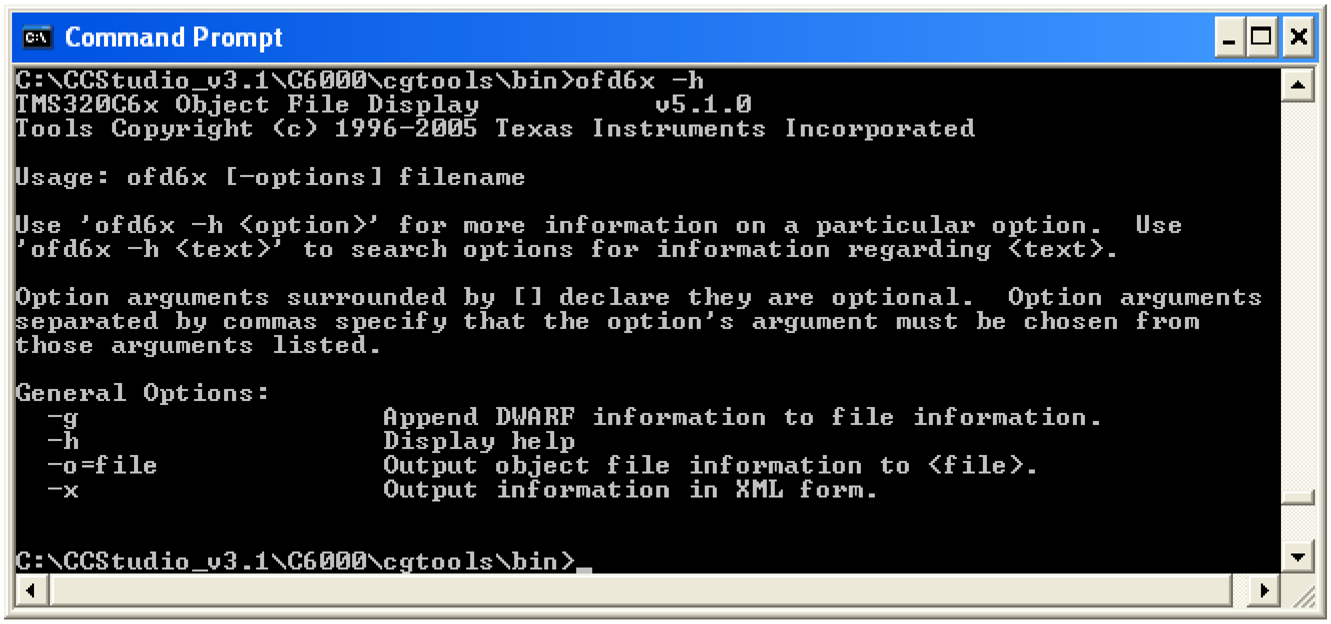
As of CGT version >= 5.0 (or CGT 3.x for ‘C55x) the code generation tools can create an XML listing file at link time in addition to a map file. We highlight this since parsing XML is far more robust than parsing the text-based map file.

The –m linker option generates a map file. The `-xml_link_info` option generates an equivalent representation in XML. In CCStudio, you can select this via Project–>Options ->Linker tab -> Advanced and filling in the fields for the XML Link info file.

Both the map and the XML file can be used to see how each memory section is allocated, and which software components are using them.

5.2 Using Object File Display Utility and CG_XML Scripts

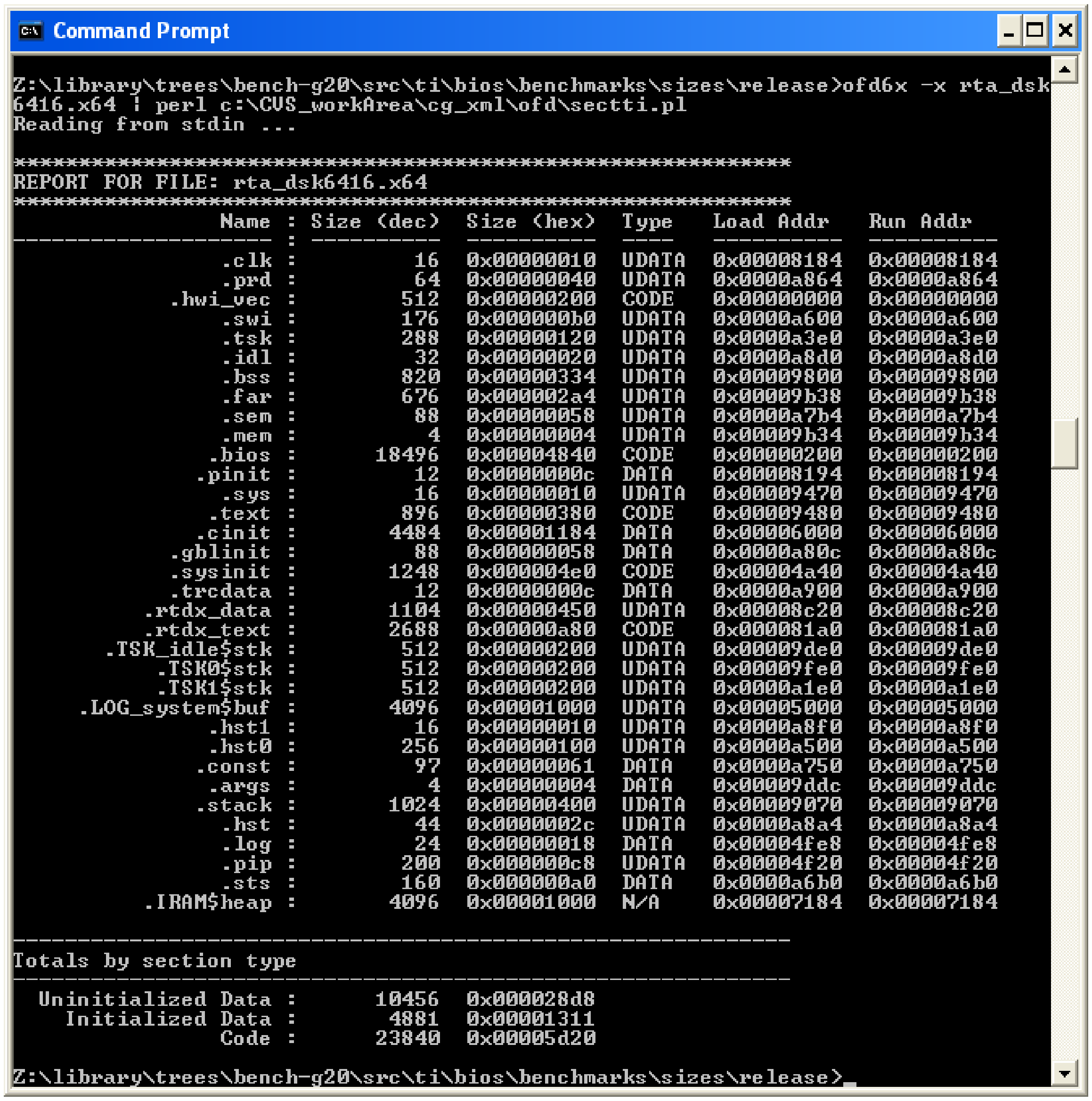
The Object File Display utility (ofdxx.exe) can be used to view the content of object files, executables, and/or archive libraries in human readable or XML format. The utility is included with the Code Composer Studio code generation tools. It can be invoked from the command prompt (DOS) shell.



```
C:\CCStudio_v3.1\C6000\cgtools\bin>ofd6x -h
TMS320C6x Object File Display           v5.1.0
Tools Copyright (c) 1996-2005 Texas Instruments Incorporated

Usage: ofd6x [-options] filename

Use 'ofd6x -h <option>' for more information on a particular option.  Use
'ofd6x -h <text>' to search options for information regarding <text>.

Option arguments surrounded by [] declare they are optional.  Option arguments
separated by commas specify that the option's argument must be chosen from
those arguments listed.

General Options:
  -g                    Append DWARF information to file information.
  -h                    Display help
  -o=file               Output object file information to <file>.
  -x                    Output information in XML form.


C:\CCStudio_v3.1\C6000\cgtools\bin>_
```

- Several Perl scripts have been developed by TI, and are delivered in a package called cg_xml. These scripts do useful things with the XML output such as generating boot images, etc. The scripts, in particular sectti.pl, were used to generate most of the sizing data here. This and other useful code generation XML parsing scripts are provided at the following web site: https://www-a.ti.com/downloads/sds_support/applications_packages/index.htm

- The sectti.pl prints the name, size, and base address of each section in an object (.obj), executable (.out), or library (.lib) file. The output file can be either a text format or a CSV (coma separated values). For example:



```
Z:\library\trees\bench-g20\src\ti\bios\benchmarks\sizes\release>ofd6x -x rta_dsk
6416.x64 | perl c:\CVS_workArea\cg_xml\ofd\sectti.pl
Reading from stdin ...

*************************************************************
REPORT FOR FILE: rta_dsk6416.x64
*************************************************************
                Name : Size (dec)  Size (hex)  Type   Load Addr   Run Addr
-------------------- : ----------  ----------  ----   ----------  ----------
                .clk :         16  0x00000010  UDATA  0x00008184  0x00008184
                .prd :         64  0x00000040  UDATA  0x0000a864  0x0000a864
            .hwi_vec :        512  0x00000200  CODE   0x00000000  0x00000000
                .swi :        176  0x000000b0  UDATA  0x0000a600  0x0000a600
                .tsk :        288  0x00000120  UDATA  0x0000a3e0  0x0000a3e0
                .idl :         32  0x00000020  UDATA  0x0000a8d0  0x0000a8d0
                .bss :        820  0x00000334  UDATA  0x00009800  0x00009800
                .far :        676  0x000002a4  UDATA  0x00009b38  0x00009b38
                .sem :         88  0x00000058  UDATA  0x0000a7b4  0x0000a7b4
                .mem :          4  0x00000004  UDATA  0x00009b34  0x00009b34
               .bios :      18496  0x00004840  CODE   0x00000200  0x00000200
              .pinit :         12  0x0000000c  DATA   0x00008194  0x00008194
                .sys :         16  0x00000010  UDATA  0x00009470  0x00009470
               .text :        896  0x00000380  CODE   0x00009480  0x00009480
              .cinit :       4484  0x00001184  DATA   0x00006000  0x00006000
            .gblinit :         88  0x00000058  DATA   0x0000a80c  0x0000a80c
            .sysinit :       1248  0x000004e0  CODE   0x00004a40  0x00004a40
            .trcdata :         12  0x0000000c  DATA   0x0000a900  0x0000a900
          .rtdx_data :       1104  0x00000450  UDATA  0x00008c20  0x00008c20
          .rtdx_text :       2688  0x00000a80  CODE   0x000081a0  0x000081a0
       .TSK_idle$stk :        512  0x00000200  UDATA  0x00009de0  0x00009de0
           .TSK0$stk :        512  0x00000200  UDATA  0x00009fe0  0x00009fe0
           .TSK1$stk :        512  0x00000200  UDATA  0x0000a1e0  0x0000a1e0
     .LOG_system$buf :       4096  0x00001000  UDATA  0x00005000  0x00005000
               .hst1 :         16  0x00000010  UDATA  0x0000a8f0  0x0000a8f0
               .hst0 :        256  0x00000100  UDATA  0x0000a500  0x0000a500
              .const :         97  0x00000061  DATA   0x0000a750  0x0000a750
               .args :          4  0x00000004  DATA   0x00009ddc  0x00009ddc
              .stack :       1024  0x00000400  UDATA  0x00009070  0x00009070
                .hst :         44  0x0000002c  UDATA  0x0000a8a4  0x0000a8a4
                .log :         24  0x00000018  DATA   0x00004fe8  0x00004fe8
                .pip :        200  0x000000c8  UDATA  0x00004f20  0x00004f20
                .sts :        160  0x000000a0  DATA   0x0000a6b0  0x0000a6b0
          .IRAM$heap :       4096  0x00001000  N/A    0x00007184  0x00007184

-------------------------------------------------------------
Totals by section type
-------------------------------------------------------------
  Uninitialized Data :      10456  0x000028d8
    Initialized Data :       4881  0x00001311
                Code :      23840  0x00005d20

Z:\library\trees\bench-g20\src\ti\bios\benchmarks\sizes\release>_
```

Table 2. Summary of Linker Section Names

Section Name	Description
.args	Arguments passed to main() (i.e., argc, argv and envp)
.bios	DSP/BIOS code
.bss	Global and static variables
.cinit	Initialization tables for global and static variables
.const	Explicitly initialized global and static constant variables and string literals
.hwi_vec	Hardware interrupt vector table
.module	DSP/BIOS module objects (.clk, .hst, .idl, etc.)
.module*	Data associated with a DSP/BIOS module object

Section Name	Description
.pinit	Table of initialization functions
.stack	Boot stack
.switch	C switch statement tables
.sysinit	System initialization code
.text	DSP/BIOS and application executable code
.trcinit	Initialization records for DSP/BIOS TRC module

6 Conclusion

The BIOS_INSTALL_DIR\packages\ti\bios\benchmarks\html\Results.html file in the 5.30 DSP/BIOS release distribution contains links to HTML files contains size information for all supported platforms.

Size data is provided in the HTML files for the applications described in this document. This information provides an estimate of the DSP/BIOS footprint for a few sample applications. Since each application is unique, techniques described in Section 5 can be used to determine the exact footprint impact.