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# SmartFusion2/IGLOO2

## Custom Flow User Guide For Libero SoC v11.7 UG0672

Designing Using External Tools for Synthesis and Simulation



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# Introduction

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Microsemi's Libero SoC software provides a fully integrated FPGA design environment. However, some users may want to use third-party Synthesis and Simulation tools outside the Libero SoC environment. Until now, you were required to use the Libero end-to-end flow for SmartFusion2 and IGLOO2 designs. Libero can now be integrated in your own FPGA design environment. While it is recommended that you use Libero SoC to manage your entire FPGA design flow whenever possible, you are no longer required to do so.

This user guide describes the Custom Flow, a process whereby you can integrate Libero as a part of your larger FPGA design flow. This document includes the following sections:

- Overview of the Custom Flow
- Component configuration
- Synthesis
- Simulation
- Firmware generation
- Implementing your final project using Libero

# 1 – Custom Flow Overview

While Libero SoC provides a fully-integrated end-to-end design environment to develop System-on-Chip designs, it does provide the users the flexibility to run synthesis and simulation with third-party tools outside the Libero SoC environment. Some design steps must, however, stay inside the Libero SoC environment.

Table 1-1 shows the major steps in the FPGA design flow, and indicates the steps for which Libero SoC must be used.

**Table 1-1 • FPGA Design Flow**

Design Flow Step	Must Use Libero?	
Design Entry: HDL	No	Use 3rd-party design-entry tool outside Libero SoC if the user so desires.
Design Entry: Configurators	Yes	Create First Libero Project for Design Generation.
Design Entry: System Builder	Yes	Stay in First Libero Project. Close project after Design Generation
Automatic PDC/SDC constraint generation	Yes	Stay in First Libero Project (Available only with Libero Enhanced Constraint Flow)
Simulation*	No	Use 3rd-party tool outside Libero SoC if the user so desires.
Synthesis	No	Use 3rd-party tool outside Libero SoC if the user so desires.
One of two ways in Design Implementation <ul style="list-style-type: none"><li>• Classic Constraint Flow (Compile, Place and Route). See Figure 1-2</li><li>• Enhanced Constraint Flow (Manage Constraints, Compile Netlist, Place and Route) See Figure 1-3</li></ul>	Yes	Create Second Libero Project for the backend implementation.
Timing and Power Verification	Yes	Stay in Second Project
Programming File Generation	Yes	Stay in Second Project
Firmware Generation	Yes	Stay in Second Project
Firmware Debug	No	Use 3rd-party tool outside Libero SoC if the user so desires.

**\*Note:** You must download precompiled libraries from [here](#) to use a third party simulator.

In a CPLD/pure Fabric FPGA flow, you enter your design using HDL or schematic entry, and pass that directly to your Synthesis tools. This is still supported. However, SmartFusion2 and IGLOO2 FPGAs have significant proprietary System on Chip (SoC) functionality. Special handling is required for any blocks that comprise SoC functionality; these blocks are hereinafter referred to as SoC Components. These are:

- SmartFusion2 MSS (includes MDDR and eNVM)
- IGLOO2 HPMS (includes MDDR and eNVM)
- System Builder
- FDDR
- SERDES
- Oscillator
- CCC

If you are using any of the above components in your design, and you want to manage the FPGA design flow outside of Libero, follow the steps provided in the rest of this guide.

## Component Lifecycle

The following steps describe the lifecycle of an SoC Component and provide instructions on how to handle its data:

1. Generate the component using its configurator in Libero SoC. This generates the following types of data:
  - a.HDL files
  - b.Memory files
  - c.Simulation stimulus files
  - d.Component metadata such as register configuration files (\*.reg) for MDDR/FDDR/SERDES and \*.cfg file for eNVM.
  - e.Firmware drivers (\*.h) files
2. For HDL files, instantiate and integrate them in the rest of your HDL design using your external Design Entry tool/process.
3. Supply memory files and stimulus files to your simulation tool.
4. Supply firmware drivers to your firmware project.
5. You must create a second Libero project, where you import the post-Synthesis netlist and your component metadata (data files about the design components, such as register configuration files and initialization files), thus completing the connection between what you generated and what you program.

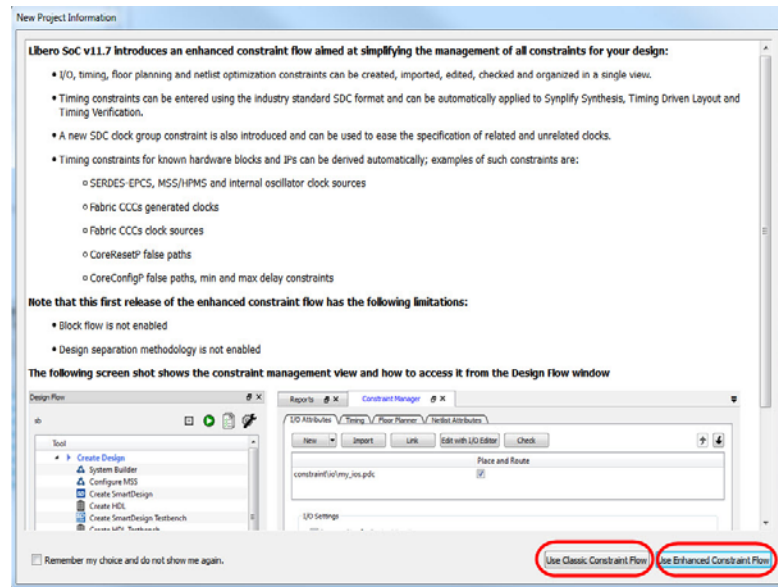
For Design Entry, if you are using SmartFusion2 or IGLOO2 SoC components (i.e., oscillators, CCC, eNVM, MSS (includes MDDR)), HPMS (includes MDDR), FDDR, or SERDES), you must use Libero SoC for part of your Design Entry (Chapter 2, "[Component Configuration](#)"), but you can then continue the rest of your Design Entry (HDL entry, and so on) outside of Libero.

## Libero SoC Project Creation

Some design steps must be run inside the Libero SoC environment ([Table 1-1](#)). For these steps to run, you need to create two Libero SoC projects. The first project is used for design component configuration and generation and the second one for physical implementation of the top level design.

## Classic Constraint Flow Versus Enhanced Constraint Flow

When you create a Libero SoC project for SmartFusion2 and IGLOO2 devices, you have a choice of the Classic Constraint Flow versus the Enhanced Constraint Flow.



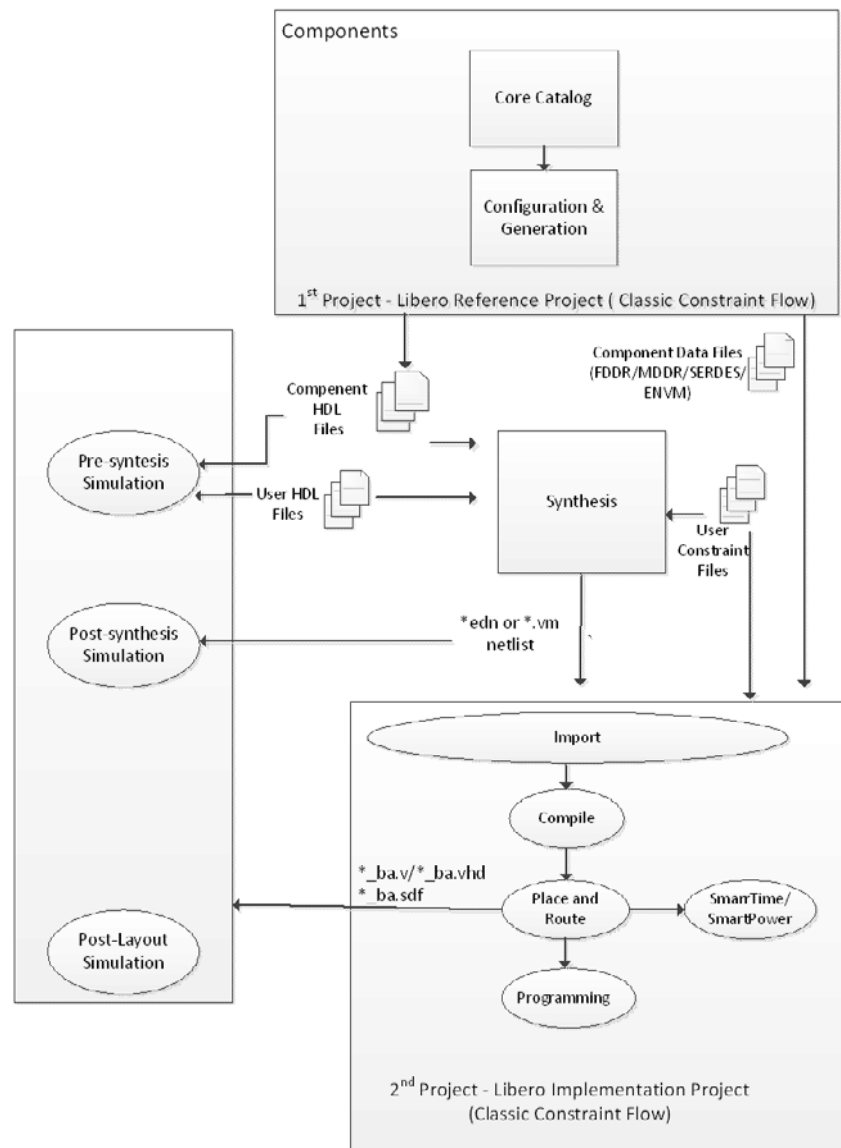
**Figure 1-1 • Project Creation Wizard - Enhanced Versus Classic Constraint Flow**

Microsemi recommends the Enhanced Constraint Flow be used for both the first project and the second (implementation) project because

- The Enhanced Constraint Flow offers the Constraint Manager to better manage all design constraints (SDC Timing, IO PDC, Floorplanning PDC and Synthesis NDC constraints). The creation, import, and edit of constraints and the association of constraints with individual design tools are controlled in one single management tool - the Constraint Manager.
- The enhanced constraint flow generates automatic SDC and PDC constraints for certain common cores such as the CCC, OSC, CoreResetP, CoreConfigP. The SDC or PDC constraints of these cores are set from the top of the design hierarchy with the full hierarchical path given. You don't need to traverse from the top of the design hierarchy to set a constraint on these IP cores, nor do you need to worry about the syntax of the SDC or PDC constraint such as hierarchy and pin separators, and design object names, etc.
- The automatically generated constraints, when applied, increase the chance of timing closure with less effort and fewer design iterations.

## Custom Flow and Libero Classic Constraint Flow

Figure 1-2 shows the Custom Flow overview with Libero SoC Classic Constraint Flow projects.



**Figure 1-2 • Custom Flow Overview (Libero Classic Constraint Flow - No automatic SDC and PDC Constraints Generation)**

The following are the steps in the Custom Flow (using Libero Classic Constraint Flow. [Figure 1-2](#)):

1. Component configuration and generation:
  - a. Create the first Libero SoC project (Reference Project), Choose Classic Constraint Flow. Configure SoC Components and instantiate in SmartDesign
  - b. Generate SmartDesign
    - This automatically exports component data and files
    - A "Component Manifests" file is also generated. For each design component, the "Component Manifests" lists the name and location of the files to be used for running third-party design

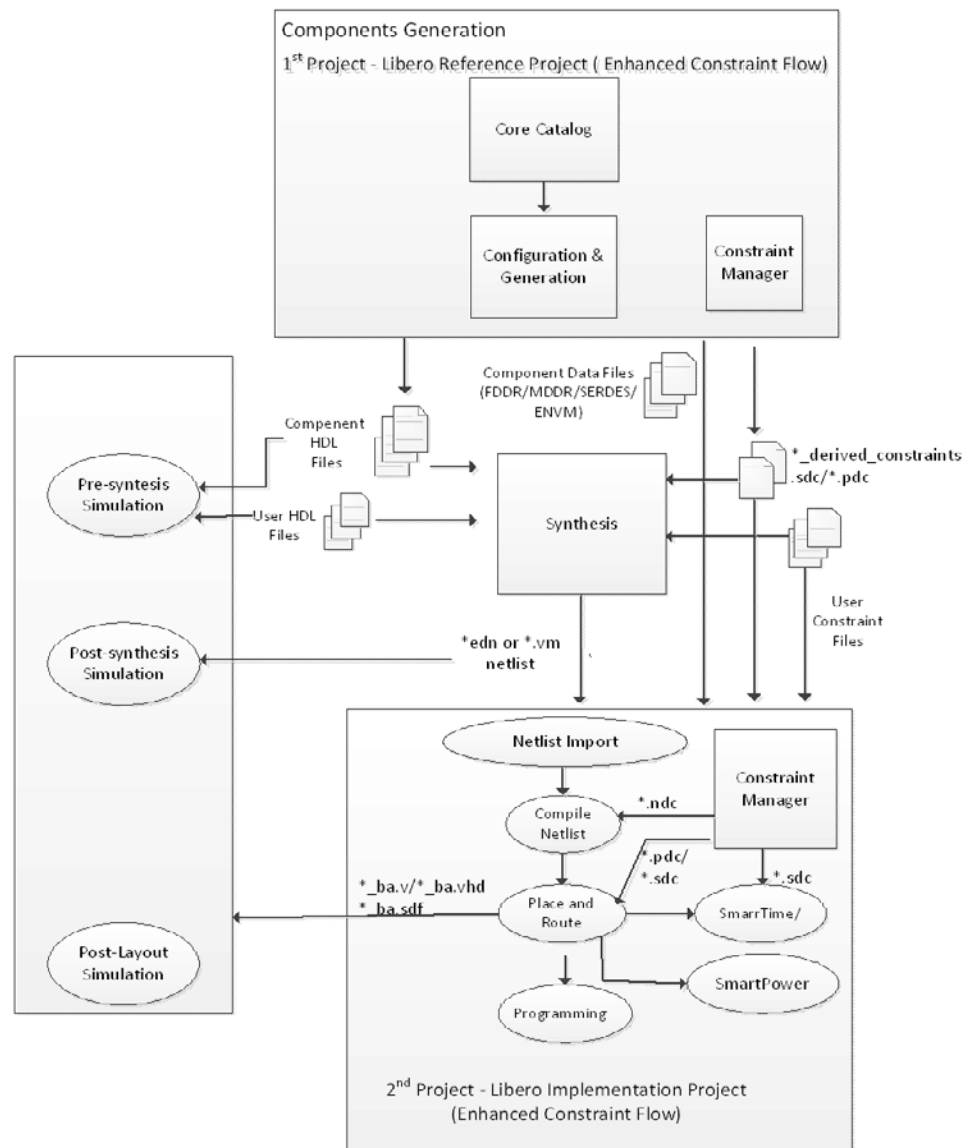
tools outside Libero, if the user so desires. See "Component Manifests" section on page 12 for details.

2. Complete your RTL design outside of Libero:
  - a. Instantiate component HDL files; the location of the HDL files is noted in the manifest.
3. Synthesis tool/Simulation tool:
  - a. Get HDL files, stimulus files, and component data from specific locations as noted in the "Component Manifests".
  - b. Synthesize and simulate outside Libero using your third-party synthesis tool and simulator.
4. Firmware tool:
  - a. Get drivers from specific locations as noted in the "Component Manifests"
  - b. Edit source code to enable runtime initialization for specific components
  - c. Compile firmware project
5. Create your second (Implementation) Libero Project. Choose Classic Constraint Flow.
6. Remove Synthesis from the design flow tool chain (**Project > Project Settings > Design Flow >** clear the **Enable Synthesis** checkbox)
7. Import Design Sources (Either \*.edn or \*.vm format)
  - Post-synthesis \*.edn netlist (**File > Import > Others**) or
  - Post-synthesis \*.vm netlist (**File > Import > HDL Source Files**)
  - Component metadata such as \*.reg file for FDDR/MDDR, SERDES and \*.cfg file for eNVM.
8. Import the design constraints:
  - File > Import > I/O constraints (PDC) Files
  - File > Import > Floorplanning Constraints (PDC) Files (Refer to "<top\_level>\_derived\_constraints.pdc (Generated in Enhanced Constraint Flow only)") if your design contains CoreConfigP
  - File > Import > Timing Constraints (SDC) Files (Refer to "<top\_level>\_derived\_constraints.sdc (Available in Enhanced Constraint Flow only)") if your design contains CCC, OSC, CoreConfigP and CoreResetP.
  - c. Associate the Constraints Files to Compile
    - Right-click the imported SDC/PDC files inside the Design Flow window and marked them as used for (associated with) Compile.
9. Complete Design Implementation
  - Run Compile, Place and Route, Programming File Generation, and so on.



## Custom Flow and Libero Enhanced Constraint Flow

Figure 1-3 shows the Custom Flow Overview with Libero Enhanced Constraint Flow projects.



**Figure 1-3 • Custom Flow Overview (Libero Enhanced Constraint Flow - Automatic SDC and PDC Constraints Generation for CCC, OSC, CoreResetP, and CoreConfigP IP Cores)**

The following are the steps in the Custom Flow (using Libero Enhanced Constraint Flow. [Figure 1-3](#)):

1. Component configuration and generation:
  - a. Create the first Libero project (Reference Project), Choose Enhanced Constraint Flow. Configure SoC Components and instantiate in SmartDesign
  - b. Generate SmartDesign
    - This automatically exports component data and files
    - A "Component Manifests" is also generated. See "Component Manifests" section on page 12 for details.
2. Generate SDC and PDC constraints for the SmartDesign components

- Select the top level in the Design Hierarchy and set as Root (RMC > Set as Root)
- Open the Constraint Manager (**Design Flow Window > Open Manage Constraints View**). Click the **Timing** Tab and then click **Derive Constraints** button to generate the floorplanning \*.pdc and the timing \*.sdc file.
- 3. Complete your RTL design outside of Libero:
  - a. Instantiate component HDL files. The location of the HDL files is listed in the "Component Manifests" files.
- 4. Synthesis tool/Simulation tool:
  - a. Get HDL files, stimulus files, and component data from specific locations as noted in the "Component Manifests".
  - b. Synthesize and Simulate the design with third-party tools outside Libero SoC.
- 5. Firmware tool:
  - a. Get drivers from specific locations as noted in the manifest
  - b. Edit source code to enable runtime initialization for specific components
  - c. Compile firmware project
- 6. Create your second (Implementation) Libero Project. Choose Enhanced Constraint Flow.
- 7. Remove Synthesis from the design flow tool chain (**Project > Project Settings > Design Flow >** clear the **Enable Synthesis** checkbox)
- 8. Import the design source files (post-synthesis \*.edn or \*.vm netlist from Synthesis tool)
  - Post-synthesis \*.edn netlist (**File > Import > Others**)
  - Post-synthesis \*.vm netlist (**File > Import > HDL Source Files**)
  - Component metadata such as \*.reg files for MDDR/FDDR, SERDES and \*.cfg file for eNVM.
- 9. Import the design constraints:
  - Import I/O constraint files (**Constraints Manager > I/O Attributes > Import**).
  - Import floorplanning \*.pdc files (**Constraints Manager > Floor Planner > Import**). If your design contains CoreConfigP, make sure to import the "<top\_level>\_derived\_constraints.pdc (Generated in Enhanced Constraint Flow only)" generated in the first Libero SoC project with the Derived Constraints button ("Generate SDC and PDC constraints for the SmartDesign components" section on page 9)
  - Import \*.sdc timing constraint files (**Constraints Manager > Timing > Import**). If your design contains CCC, OSC, CoreConfigP and CoreResetP IP cores, makes sure to import the "<top\_level>\_derived\_constraints.sdc (Available in Enhanced Constraint Flow only)" file generated in the first Libero SoC project with the Derived Constraints button ("Generate SDC and PDC constraints for the SmartDesign components" section on page 9).
  - Import \*.ndc constraint files (**Constraints Manager > Netlist Attributes > Import**), if any.
- 10. Constraint File and Tool Association
  - In the Constraint Manager, associate the \*.pdc files to Place and Route, the \*.sdc files to Place and Route and Timing Verifications, and the \*.ndc files to Compile Netlist.
- 11. Complete Design Implementation
  - Run Compile Netlist, Place and Route, Programming File Generation, and so on

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## 2 – Component Configuration

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The first step in the Custom Flow is to configure your Components using a Libero project. In subsequent steps, you will use data from this reference project.

If you are using any of the following components in your design, you must perform the steps described in this section:

- SmartFusion2 MSS
- IGLOO2 HPMS
- MDDR
- FDDR
- SERDES
- eNVM
- CCC

If you are not using any of the above components, you can write your RTL outside of Libero, and import it into your Synthesis and Simulation tools directly. You can then proceed to the post-synthesis section and only import your post-synthesis \*.edn or \*.vm netlist into your final Libero project.

### Component Configuration Using Libero

After you have selected the Components you are going to use from the above list, perform the following steps:

1. Create a new Libero project (Core Configuration and Generation):
  - a. Select the Device and Family that you are targeting your final design to.
  - b. If you are using the SmartFusion2 MSS, or if you would like to use System Builder, make the appropriate selection in the “Use Design Flow” section of the New Project Window. Microsemi recommends using System Builder (for both SmartFusion2 and IGLOO2) to configure any of the above Components.
2. If you are using System Builder (for IGLOO2, you must use System Builder to configure the HPMS, eNVM, MDDR, and FDDR):
  - a. Use System Builder to select your components and configure your system. Refer to the [SmartFusion2 System Builder User's Guide](#) or the [IGLOO2 System Builder User's Guide](#) for details.
  - b. Generate your system in System Builder, and promote all its ports to the top level SmartDesign (select all ports, right-click, and choose **Promote to Top**).
    - Note the port names—you will need them to connect the rest of your design to the generated system.
  - c. Instantiate and configure any CCC or SERDES blocks in the same top level SmartDesign or in another SmartDesign component. Again, promote any ports to top.
  - d. Generate any SmartDesign instances.
  - e. Double-click the “Simulate” tool (any one of Pre-Synthesis or Post-Synthesis or Post-Layout options) to invoke the Simulator. You can exit the simulator once it is invoked—this step will generate the simulation files necessary for your project.

**Note:** You must perform this step if you want to simulate your design outside of Libero.
  - f. Save your project—this is your Reference Project.
3. If you are not using System Builder (SmartFusion2 only):
  - a. If you select the SmartFusion2 MSS in the “Use Design Flow” subsection (step 1b above), the SmartFusion2 MSS Configurator will automatically open. Otherwise, in the Design Flow window, double-click **Configure MSS**.

- Libero automatically creates a new SmartDesign for you, in which the MSS will be instantiated. Double-click the MSS instance to open its configurator.
- Configure the SmartFusion2 MSS as per your requirements. Refer to the [SmartFusion2 MSS Users Guides](#) for details.

**Note:** If you are using the eNVM or the MDDR, you must use the MSS to configure it

- Save and generate the MSS component

**Note:** If you are not using System Builder, and you have MSS (using MDDR) or FDDR or SERDES blocks in your design, you must

a. Construct the Peripheral Initialization architecture in your final design. Refer to the [SmartFusion2 Peripheral Initialization User's Guide](#) or the [IGLOO2 Peripheral Initialization User's Guide](#) for details.

b. Instantiate and configure any FDDR, CCC or SERDES blocks in the top level SmartDesign. It is not necessary to connect them to anything else—just promote any ports to top.

c. Generate all SmartDesigns built in steps a and b above.

d. Double-click the “Simulate” tool (any of Pre-Synthesis or Post-Synthesis or Post-Layout options) to invoke the Simulator. You can exit the simulator after it is invoked; this step simply generates the simulation files necessary for your project.

**Note:** You must perform this step if you want to simulate your design outside of Libero.

e. Skip to Step 4 for Classic Constraint Flow. For Enhanced Constraint Flow, Open the Constraint Manager (**Design Flow** window > **Manage Constraints** > **Open Manage Constraints View**). Click the Timing Tab and click Derived Constraints. Click **Yes** when asked whether you want to associate the \*.sdc constraint file to Synthesis, Place and Route, and Timing Verifications and associate the \*.pdc file to Place and Route. A <top\_level>\_derived\_constraints.sdc file is generated for timing constraints. This file is located in <proj\_location/constraints/<top\_level>/derived\_constraints.sdc.

A <top\_level>\_derived\_constraints.pdc file is generated for floorplanning constraints. This file is located in <proj\_location/constraints/fp/<top\_level>\_derived\_constraints.pdc. Note the location of this file. You need to pass this \*.sdc file to Synthesis when you exit Libero and run Synthesis outside Libero. For the floorplanning PDC constraint file, you need to pass it to Place and Route in the second Libero Project you will create to implement your design.

f. Save your project—this is your Reference Project.

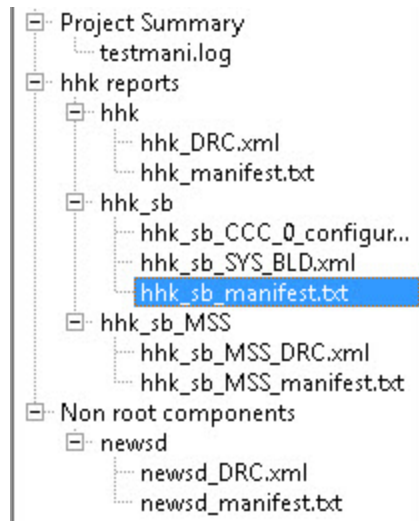
4. If you are using SmartFusion2, and using any of the MSS peripherals (MDDR, FDDR, or SERDES), you must export your firmware project (SoftConsole/IAR/Keil) from this Libero project. Refer to Chapter 6, “[Building Your Firmware Project](#)” for more details.

**Note:** You must follow DRCs for Components that you instantiate. For example, if you have multiple SERDES instances in your design, make sure that each SERDES instance is configured to select a different physical SERDES block. Refer to the user guides for the respective Component DRCs for details.

## Component Manifests

When you generate your SmartDesign components, a set of files is generated for each component. The Component Manifest Report details the set of files generated and used in each subsequent step (Synthesis, Simulation, Firmware Generation, and so on). This report gives you the locations of all the generated files needed to proceed with the Custom Flow. You can access the component manifest in the Reports area: Click **Design > Reports** to open the reports tab. In the reports tab, you will see a set of manifest.txt files ([Figure 2-1](#)), one for each component you generated. Focus on the following Component Manifest Reports:

- If you are using System Builder, read the file <system builder name>\_sb\_manifest.txt.
- If you instantiated components into a SmartDesign, read the file <smartdesign\_name>\_manifest.txt.



**Figure 2-1 • <smartdesign\_name>\_manifest.txt File**

In this project (Figure 2-1), a System Builder component (hhk\_sb) instantiates MSS and FDDR, and a separate SmartDesign (newsd) instantiates two SERDES blocks. The relevant files to focus on for this design are hhk\_sb\_manifest.txt and newsd\_manifest.txt.

You must use all "Component Manifests" Reports that apply to your design. For example, if you instantiate two SmartDesigns, one with a SERDES block and one with an MSS, you must select files from both "Component Manifests" Reports for use in your design flow.

## Interpreting Manifest Files

When you open a manifest file (in the Reports Tab), you will see paths to files in your Libero project, and pointers on where in the design flow to use them. You may see the following types of files in a manifest file:

- HDL source files for all Synthesis and Simulation tools
- HDL source files for Synopsys SynplifyPro Synthesis tool
- HDL source files for Mentor Precision Synthesis tool
- Stimulus files for all Simulation tools
- Configuration files to be used for all Simulation tools
- Firmware files for all Software IDE tools
- Configuration files to be used for Programming
- Configuration files to be used for Power Analysis

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HDL source files for all Synthesis and Simulation tools:

- C:/temp/testmani/component/Actel/DirectCore/CoreAHBLite/5.2.100/rtl/vlog/core/coreahblite.v
- C:/temp/testmani/component/Actel/DirectCore/CoreAHBLite/5.2.100/rtl/vlog/core/coreahblite\_addrdec.v
- C:/temp/testmani/component/Actel/DirectCore/CoreAHBLite/5.2.100/rtl/vlog/core/coreahblite\_defaults\_lavesm.v
- C:/temp/testmani/component/Actel/DirectCore/CoreAHBLite/5.2.100/rtl/vlog/core/coreahblite\_masterstage.v
- C:/temp/testmani/component/Actel/DirectCore/CoreAHBLite/5.2.100/rtl/vlog/core/coreahblite\_matrix4x16.v
- C:/temp/testmani/component/Actel/DirectCore/CoreAHBLite/5.2.100/rtl/vlog/core/coreahblite\_slavearbitrator.v
- C:/temp/testmani/component/Actel/DirectCore/CoreAHBLite/5.2.100/rtl/vlog/core/coreahblite\_slavestage.v
- C:/temp/testmani/component/Actel/DirectCore/CoreConfigP/7.0.105/rtl/vlog/core/coreconfigp.v
- C:/temp/testmani/component/Actel/DirectCore/CoreResetP/7.0.104/rtl/vlog/core/coreresetp.v
- C:/temp/testmani/component/Actel/DirectCore/CoreResetP/7.0.104/rtl/vlog/core/coreresetp\_pcie\_hotreset.v
- C:/temp/testmani/component/work/hhk\_sb/CCC\_0/hhk\_sb\_CCC\_0\_FCCC.v
- C:/temp/testmani/component/work/hhk\_sb/FABDDR\_0/hhk\_sb\_FABDDR\_0\_FDDRC.v
- C:/temp/testmani/component/work/hhk\_sb/FABOSC\_0/hhk\_sb\_FABOSC\_0\_OSC.v
- C:/temp/testmani/component/work/hhk\_sb/hhk\_sb.v
- C:/temp/testmani/component/work/hhk\_sb\_MSS/hhk\_sb\_MSS.v

HDL source files for Synopsys SynplifyPro Synthesis tool:

- C:/temp/testmani/component/Actel/SgCore/OSC/1.0.105/osc\_comps.v
- C:/temp/testmani/component/work/hhk\_sb/FABDDR\_0/hhk\_sb\_FABDDR\_0\_FDDRC\_syn.v
- C:/temp/testmani/component/work/hhk\_sb\_MSS/hhk\_sb\_MSS\_syn.v

HDL source files for Mentor Precision Synthesis tool:

- C:/temp/testmani/component/Actel/SgCore/OSC/1.0.105/osc\_comps\_pre.v
- C:/temp/testmani/component/work/hhk\_sb/FABDDR\_0/hhk\_sb\_FABDDR\_0\_FDDRC\_pre.v
- C:/temp/testmani/component/work/hhk\_sb\_MSS/hhk\_sb\_MSS\_pre.v

Stimulus files for all Simulation tools:

- C:/temp/testmani/component/Actel/SmartFusion2MSS/MSS/1.1.400/peripheral\_init.bfm
- C:/temp/testmani/component/work/hhk\_sb/subsystem.bfm
- C:/temp/testmani/component/work/hhk\_sb\_MSS/CM3\_compile\_bfm.tcl
- C:/temp/testmani/component/work/hhk\_sb\_MSS/test.bfm
- C:/temp/testmani/component/work/hhk\_sb\_MSS/user.bfm

Firmware files for all Software IDE tools:

- C:/temp/testmani/component/work/hhk\_sb/FABDDR\_0/sys\_config\_fddr\_define.h
- C:/temp/testmani/component/work/hhk\_sb\_MSS/sys\_config\_mddr\_define.h
- C:/temp/testmani/component/work/hhk\_sb\_MSS/sys\_config\_mss\_clocks.h

Configuration files to be used for Programming:

- C:/temp/testmani/component/work/hhk\_sb\_MSS/ENVM.cfg

Configuration files to be used for all Simulation tools:

- C:/temp/testmani/component/work/hhk\_sb/FABDDR\_0/FDDR\_init.bfm
- C:/temp/testmani/component/work/hhk\_sb\_MSS/ENVM.cfg
- C:/temp/testmani/component/work/hhk\_sb\_MSS/MDDR\_init.bfm

Configuration files to be used for Power Analysis:

- C:/temp/testmani/component/work/hhk\_sb/FABDDR\_0/FDDR\_init.reg
- C:/temp/testmani/component/work/hhk\_sb\_MSS/MDDR\_init.reg

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**Figure 2-2 • Example Component Manifest Report - System Builder Block for SmartFusion2, with MDDR, FDDR, and eNVM**

Each type of file is necessary downstream in your design flow. The following chapters describe how to integrate files from the manifest into your design flow.

**Note:** The <proj\_location>/<top\_level>\_derived\_constraints.sdc and the <proj\_location>/<top\_level>\_derived\_constraints.pdc file are not included in the Manifest file. Note the location of the \*.sdc file and \*.pdc file. These two files are used downstream in the custom flow. The two files are given in "SDC Timing Constraints" section on page 23 and "PDC Physical Design Constraints" section on page 24 in Appendix B.

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## 3 – Synthesizing Your Design

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One of the primary features of the Custom Flow is to allow you to use a third-party synthesis tool with Libero. The custom flow supports the use of Synopsys SynplifyPro or Mentor Graphics Precision as third-party synthesis tool. To synthesize your project, follow the steps below:

1. Create a new project in your Synthesis tool, targeting for the same device family, die and package as the Libero project your first created.
    - a. Import your own RTL files as you normally do.
    - b. Set the Synthesis output to be either EDIF (.edn) or Structural Verilog (.vm).
  2. Import Component HDL Files into your Synthesis project:
    - a. For each "Component Manifests" Report:
      - For each file under "HDL source files for all Synthesis and Simulation tools", Import the file into your Synthesis Project.
      - Depending on whether you are using Synplify or Precision, also import all files under "HDL source files for Synopsys SynplifyPro Synthesis tool" or "HDL source files for Mentor Precision Synthesis tool", respectively.
  3. If your design contains the CCC, OSC, CoreConfigP, or CoreResetP IP cores, import the <top\_level>\_derived\_constraints.sdc in Appendix A "<top\_level>\_derived\_constraints.sdc" into the Synthesis tool. This constraint file constrains the synthesis tool to achieve timing closure with less effort and fewer design iterations.
- Note: If you plan to use the same \*.sdc file to constrain Place and Route during the design implementation phase, You must import this <top\_level>\_derived\_constraints.sdc into the synthesis project. This is to ensure that there are no design object name mismatches in the synthesized netlist and the Place and Route constraints during the implementation phase of the design process. If you don't include this \*.sdc file in the Synthesis step, the netlist generated from Synthesis may fail the Place and Route step because of design object name mismatches.*
4. Import any Netlist Attributes \*.ndc, if any, into the Synthesis tool.
  5. Run Synthesis.

Note the location of your Synthesis tool output \*.edn or \*.vm netlist. You need to import the netlist into the Libero Implementation Project to continue with the design process.

## 4 – Simulating Your Design

To simulate your design outside of Libero (i.e., using your own simulation environment and simulator), follow the steps below:

### 1. Design Files

#### a. Pre-synthesis simulation:

- Import your RTL into your simulation project
- For each "Component Manifests" Report
  - Import each file under "HDL source files for all Synthesis and Simulation tools" into your simulation project
- Compile these files as per your simulator's instructions

#### b. Post-synthesis simulation:

Import your post-synthesis \*.edn or \*.vm netlist (generated in Section 3, "Synthesizing Your Design") into your simulation project and compile it

#### c. Post-layout simulation:

First, complete implementing your design (see Chapter 5, "Implementing Your Design"). Ensure that your final Libero project is in post-layout state.

Double-click **Generate Back Annotated Files** in the Libero Design Flow window. This will generate two files:

```
<project directory>/designer/<root>/<root>_ba.v/vhd
<project directory>/designer/<root>/<root>_ba.sdf
```

Import both of these files into your simulation tool.

### 2. Stimulus and Configuration files:

#### a. For each "Component Manifests" Report:

- Copy all files under the "Configuration files to be used for all Simulation tools" and "Stimulus Files for all Simulation Tools" sections to the root directory of your Simulation project.

#### b. Ensure that any Tcl files in the above lists (in 2.a) are executed first, before the start of simulation.

#### c. SmartFusion2 only:

Review the "subsystem.bfm" file. Based on your usage of the MDDR, FDDR, or SERDES, ensure that the following lines are present (or absent) in the subsystem.bfm file—presence indicates that the Component is used in your design, absence indicates that the Component is not used:

```
#-----
# Peripheral Initialization
#-----
#define USE_MDDR
#define USE_FDDR
#define USE_SERDESIF_0
#define USE_SERDESIF_1
#define USE_SERDESIF_2
#define USE_SERDESIF_3
```

d. ENVM\_init.mem: If you are using the eNVM(SmartFusion2 or IGLOO2), or if you are using IGLOO2 and are using MDDR, FDDR, or SERDES, you must copy the ENVM\_init.mem file to the simulation directory, regardless of whether or not you use eNVM. This file is located in the simulation directory of the Libero project used to instantiate either System Builder or the MSS.

*Note:* To simulate the functionality of SoC Components, you will need the precompiled SmartFusion2/IGLOO2 simulation libraries. Download them from the Microsemi website, and import them into your simulation environment as described [here](#).



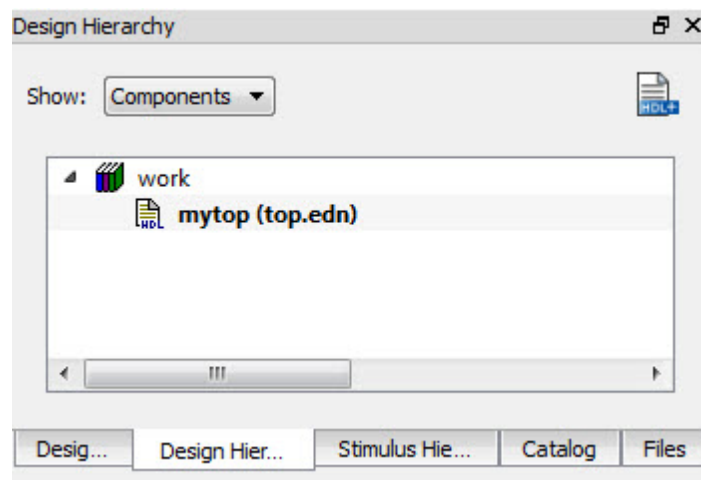
## 5 – Implementing Your Design

After you have completed Synthesis and Post-Synthesis simulation in your environment, you must use Libero again to physically implement your design, run timing and power analysis, and generate your programming file.

1. Create a new Libero project for the physical implementation and layout of the design. Make sure to target the same device as in the reference project you created in Chapter 2, "Component Configuration".
2. Select the same design flow (Enhanced Constraint or Classic Constraint Flow) as the reference project you first create for design component configuration and generation. If the reference project you first create is for the Classic Constraint Flow, create a Libero Classic Constraint Flow project. for design implementation. If the reference project you first create is for the Enhanced Constraint Flow, create an Enhanced Constraint Flow project for design implementation.
3. After project creation, remove Synthesis from the tool chain in the Design Flow Window (**Project > Project Settings > Design Flow > Uncheck Enable Synthesis**)
4. Import your post-synthesis \*.edn or \*.vm file into this project, (**File > Import > Others or File > HDL Source Files**).

**Note:** It is recommended that you create a link to this file, so that if you re-synthesize your design, Libero always uses the latest post-synthesis netlist.

- a. In the Design Hierarchy window, note the name of the root module (shown in bold in Figure 5-1). >



**Figure 5-1 • Root Module in Design Hierarchy**

5. Import the constraints into the Libero project.
  - For Classic Constraint Flow, use the **File > Import** menu to import constraints file
    - Import I/O PDC files (**File > Import > I/O Constraints (PDC) File**)
    - Import floorplanning PDC files (**File > Import > Floorplanning Constraints (PDC) Files**)
    - Import SDC timing constraint file (**File > Import > Timing Constraints (SDC) Files**).
  - For Enhanced Constraint Flow, use the Constraint Manager to import \*.pdc and \*.sdc constraints.
    - Import I/O \*.pdc constraint files (**Constraints Manager > I/O Attributes > Import**).

- Import Floorplanning \*.pdc constraint files (**Constraints Manager > Floor Planner > Import**). If your design contains CoreConfigP, make sure to import the "<top\_level>\_derived\_constraints.pdc (Generated in Enhanced Constraint Flow only)" file.
  - Import \*.sdc timing constraint files (**Constraints Manager > Timing > Import**). If your design contains CCC, OSC, CoreConfigP and CoreResetP IP cores, make sure to import the "<top\_level>\_derived\_constraints.sdc (Available in Enhanced Constraint Flow only)" file.
  - Import \*.ndc constraint files (**Constraints Manager > Netlist Attributes > Import**)
6. Associate Constraints Files to design tools
- For Classic Constraint Flow, right-click the imported constraint file in the Design Flow window and select **Use for Compile**. This associates the design constraint file to the Compile step.
  - For Enhanced Constraint Flow, open Constraint Manager (**Manage Constraints > Open Manage Constraints View**). Check the Place and Route and Timing Verifications checkbox next to the constraint file to establish constraint file and tool association. Associate the \*.pdc constraint to Place and Route and the \*.sdc to both Place and Route and Timing Verifications. Associate the \*.ndc file to Compile Netlist.

*Note: The <top\_level>\_derived\_constraints.SDC timing constraint file constrains IP Cores such as CCC, OSC, CoreResetP and CoreConfigP to achieve timing closure with less effort and fewer design iterations. If Place and Route fails with this \*.sdc constraint file, import this same \*.sdc file to synthesis and re-run synthesis.*

*Note: The floorplanning \*.pdc file constrains the CoreConfigP in an optimal location for placement. and improves timing performance of the design.*

- For Classic Constraint Flow, click **Compile** and then **Place and Route** to complete the layout step.
- For Enhanced Constraint flow, click **Compile Netlist** and then **Place and Route** to complete the layout step.

7. From all "Component Manifests" Reports:

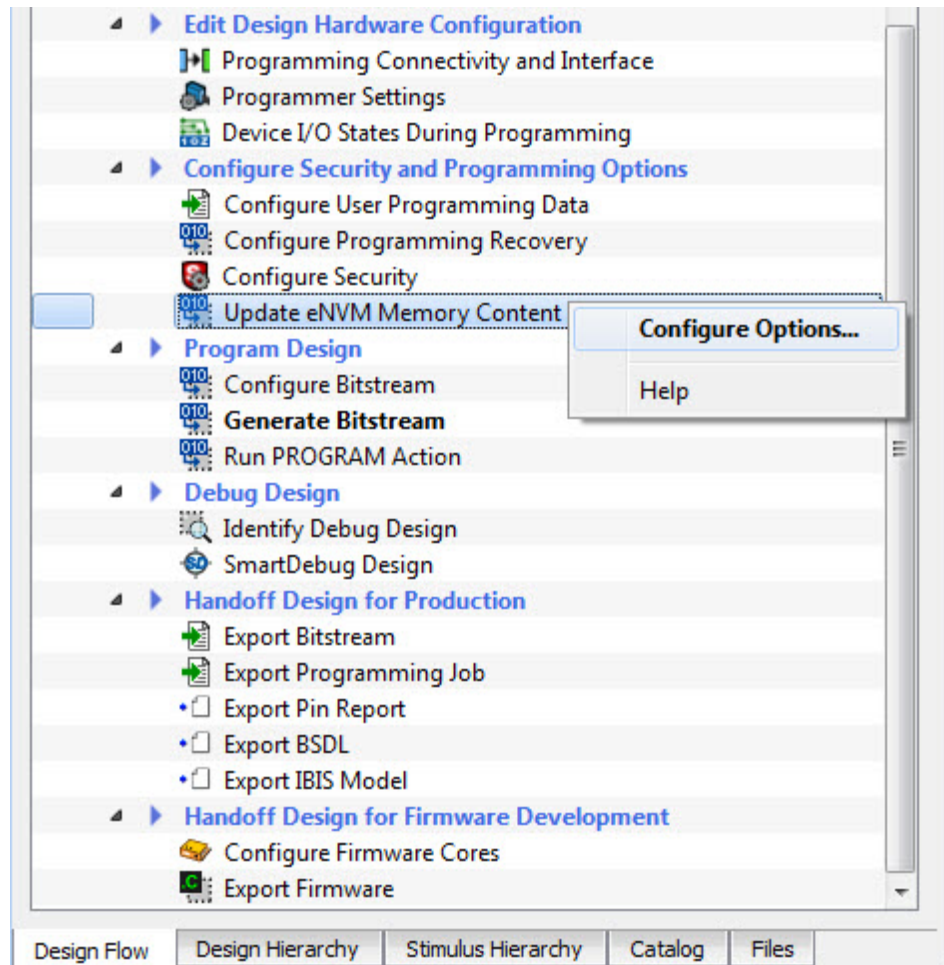
a. Import all the files in the "Configuration files to be used for Programming" and "Configuration files to be used for Power Analysis" sections using the `import_component_data` Tcl command:

```
import_component_data
-module <name of root component>
-fddr < path to FDDR.reg >
-mddr < path to MDDR.reg >
-serdes0 < path to SERDESIF_0_init.reg >
-serdes1 < path to SERDESIF_1_init.reg >
-serdes2 < path to SERDESIF_2_init.reg >
-serdes3 < path to SERDESIF_3_init.reg >
-envm_cfg < path to ENVM cfg>
```

*Note: All configuration files imported with the `import_component_data` Tcl command are imported to the designer/<root name>/component/ folder in the Libero project directory.*

*Note: For SmartFusion2, if you will not be running SmartPower, you can skip importing the \*.reg files, and you only need to import the ENVM.cfg file. For IGLOO2, you must import all \*.reg and ENVM.cfg files specified in all your relevant "Component Manifests" Reports.*

8. If you need to change eNVM content, open the "Update eNVM Memory Content" dialog box (Figure 5-2). Changes you make in this dialog box will be saved to the eNVM \*.cfg file you imported in Step 7.



**Figure 5-2 • Update eNVM Memory Content**

9. Generate a Programming File from this project and use it to program your FPGA.

---

## 6 – Building Your Firmware Project

---

This section describes how to build your firmware project when using the Custom Flow. There are three types of files that make up a firmware project:

- Source files (i.e., your firmware application)
- Drivers: These are drivers provided to facilitate your use of SmartFusion2 SoC Components as well as Microsemi-provided Soft IP blocks. They include the CMSIS Hardware Abstraction Layer, which facilitates the use of the Cortex-M3 processor, and peripheral drivers (for example, MSS SPI, MSS UART, and so on)
- Peripheral Initialization Drivers: These files are generated by Libero SoC if you are using the MDDR, FDDR, or SERDES Components. Libero translates configuration settings for these blocks into register values that are stored in these files. You must import these into your firmware project manually, as shown below

Build your firmware project as follows:

(Steps 1-4 are detailed in the SmartFusion2 CMSIS Hardware Abstraction Layer User Guide, which you can access using the Firmware Catalog.)

1. Select a Software IDE Tool—Microsemi provides drivers compatible with Microsemi's SoftConsole, Keil MDK, or IAR Embedded Workbench.
2. Use the Firmware Catalog to download driver files for SoC Components or Microsemi Soft IP you are using in your Libero project.
3. Create a new firmware project using your Software IDE tool of choice.
4. Import driver files, and write your application code as you normally do.
5. Create a "<my\_project>/drivers\_config/sys\_config" directory in your firmware project.
6. For each "Component Manifests" Report (generated in "Component Configuration"):
  - a. Import each file in the "Firmware files for all Software IDE tools" section (Figure 2-2 on page 14) into your firmware project's drivers\_config/sys\_config directory.
7. Navigate to your Libero installation directory (i.e., where Libero is installed), and then navigate to the following directory:

```
<Libero install dir>\data\apa4m\sysconfig
```

a. There are two files here—sysconfig.c and sysconfig.h.

b. Import sysconfig.c (as is, do not modify the file) into your firmware project's drivers\_config/sys\_config directory.

c. Edit the local copy of sysconfig.h:

- If you are using the MDDR, change the following line:

```
#define SYS_MDDR_CONFIG_BY_CORTEX    0  
to:  
#define SYS_MDDR_CONFIG_BY_CORTEX    1
```

- Similarly, depending on whether you are using FDDR and SERDES blocks 0 to 3 in your design, change their respective lines as above. Figure 6-1 highlights the areas that must be changed.
- Import sysconfig.h into your firmware project's drivers\_config/sys\_config directory.

## 8. Proceed with compilation of your firmware project.

---

```

/*=====
 * MDDR configuration
 */
#define MSS_SYS_MDDR_CONFIG_BY_CORTEX      0

/*=====
 * FDDR configuration
 */
#define MSS_SYS_FDDR_CONFIG_BY_CORTEX      0

/*=====
 * SERDES Interface configuration
 */
#define MSS_SYS_SERDES_0_CONFIG_BY_CORTEX  0
#if MSS_SYS_SERDES_0_CONFIG_BY_CORTEX
#include "sys_config_SERDESIF_0.h"
#endif

#define MSS_SYS_SERDES_1_CONFIG_BY_CORTEX  0
#if MSS_SYS_SERDES_1_CONFIG_BY_CORTEX
#include "sys_config_SERDESIF_1.h"
#endif

#define MSS_SYS_SERDES_2_CONFIG_BY_CORTEX  0
#if MSS_SYS_SERDES_2_CONFIG_BY_CORTEX
#include "sys_config_SERDESIF_2.h"
#endif

#define MSS_SYS_SERDES_3_CONFIG_BY_CORTEX  0
#if MSS_SYS_SERDES_3_CONFIG_BY_CORTEX
#include "sys_config_SERDESIF_3.h"
#endif

```

---

**Figure 6-1 • Editing sysconfig.h—only edit the values highlighted in red to bring them in line with your design's usage**

---

## A – Libero-generated hardware configuration files

---

This appendix describes the hardware configuration files that are generated by Libero. These files are intended to be imported into a firmware project (Chapter 6, "Building Your Firmware Project"). Depending on the components present in a design, not all of these files will be present.

### **sys\_config.h**

This header file contains information about the SmartFusion2 MSS hardware configuration. It is generated by the Libero hardware design flow. The content of this file is hardware design specific. This file should not be included in application code.

### **sys\_config.c**

This C source file contains information about the SmartFusion2 MSS hardware configuration. It is generated by the Libero hardware design flow. The content of this file is hardware design specific. This file must be part of your software project if the hardware design uses one of the DDR memory controllers or a SERDES interface.

### **sys\_config\_mss\_clocks.h**

This header file contains information about the SmartFusion2 MSS hardware clock configuration. It is generated by the Libero hardware design flow. The content of this file is hardware design specific. This file should not be included in application code.

### **sys\_config\_mddr\_define.h**

This header file contains information about the SmartFusion2 MSS DDR hardware configuration. It is generated by the Libero hardware design flow if DDR is included in the Libero design. The content of this file is hardware design specific. This file should not be included in application code.

### **sys\_config\_SERDESIF\_<0-3>.c**

These C source files contain information about the SmartFusion2 SERDES interface hardware configuration. They are generated by the Libero hardware design flow if SERDES interfaces are included in the Libero design. A separate file is generated for each SERDES interface. The content of these files is hardware design specific. These files must be part of your software project if the hardware design uses one or more SERDES interfaces.

### **sys\_config\_SERDESIF\_<0-3>.h**

These header files contain information about the SmartFusion2 SERDES interface hardware configuration. They are generated by the Libero hardware design flow if SERDES interfaces are included in the Libero design. A separate file is generated for each SERDES interface. The content of these files is hardware design specific. These files should not be included in application code.

## B – Sample SDC and PDC Constraints

For certain IP cores such as CCC, OSC, CoreResetP and CoreConfigP, Libero SoC generates SDC and PDC timing constraints. Passing the SDC and/or PDC constraints to design tools increases the chance of meeting timing closure with less effort and fewer design iterations. The full hierarchical path from the top level instance is given for all design objects referenced in the constraints.

### SDC Timing Constraints

For the Libero SoC Enhanced Constraint Flow, this top-level SDC constraint file is available from the Constraint Manager (**Design Flow > Open Manage Constraint View > Timing > Derive Constraints**). Modify, if necessary, the full hierarchical path and design object names to match the names used in your design.

*Note: This file is NOT generated for the Classic Constraint Flow, even if your design contains CCC, OSC, CoreResetP and CoreConfigP components. Refer to this file to set the SDC constraints for these components. Modify the full hierarchical path, if necessary, to match your design hierarchy. Save the file to a different name and import the SDC file to the synthesis tool, Place and Route Tool and Timing Verifications, just like any other SDC constraint files.*

#### <top\_level>\_derived\_constraints.sdc (Available in Enhanced Constraint Flow only)

```
# Microsemi Corp.
# Date: 2016-Aug-08 11:49:33
#Libero SoC uses "/" as the hierarchy separator and pin separators in the *.sdc file

create_clock -name {<top_level_instance_name>/FABOSC_0/I_RCOSC_25_50MHZ/CLKOUT}\
-period 20 \
[get_pins \
{<top_level_instance_name>/FABOSC_0/I_RCOSC_25_50MHZ/CLKOUT}]
create_clock -name {<top_level_instance_name>/mddr_top_sb_MSS_0/CLK_CONFIG_APB} \
-period 40 \
[get_pins {\
<top_level_instance_name>/mddr_top_sb_MSS_0/MSS_ADLIB_INST/CLK_CONFIG_APB}]
create_generated_clock -name {<top_level_instance_name>/CCC_0/GL0}\
-multiply_by 4 -divide_by 2 \
-source [get_pins {<top_level_instance_name>/CCC_0/CCC_INST/RCOSC_25_50MHZ}]\
-phase 0 \
[get_pins {<top_level_instance_name>/CCC_0/CCC_INST/GL0}]
set_false_path -ignore_errors -through [get_nets {\
<top_level_instance_name>/CORECONFIGP_0/INIT_DONE\
<top_level_instance_name>/CORECONFIGP_0/SDIF_RELEASED}]
set_false_path -ignore_errors -through [get_nets {\
<top_level_instance_name>/CORERESETP_0/ddr_settled \
<top_level_instance_name>/CORERESETP_0/count_ddr_enable\
<top_level_instance_name>/CORERESETP_0/release_sdif*_core\
<top_level_instance_name>/CORERESETP_0/count_sdif*_enable}]
set_false_path -ignore_errors -from [get_cells {\
<top_level_instance_name>/CORERESETP_0/MSS_HPMS_READY_int}] -to [get_cells {\
<top_level_instance_name>/CORERESETP_0/sm0_areset_n_rcosc\
<top_level_instance_name>/CORERESETP_0/sm0_areset_n_rcosc_q1}]
```



```

set_false_path -ignore_errors -from [get_cells {\
<top_level_instance_name>/CORERESETP_0/MSS_HPMS_READY_int\
<top_level_instance_name>/CORERESETP_0/SDIF*_PERST_N_re}] -to [get_cells {\
<top_level_instance_name>/CORERESETP_0/sdif*_areset_n_rcosc*}]

set_false_path -ignore_errors -through [get_nets {\
<top_level_instance_name>/CORERESETP_0 CONFIG1_DONE\
<top_level_instance_name>/CORERESETP_0/CONFIG2_DONE\
<top_level_instance_name>/CORERESETP_0/SDIF*_PERST_N \
<top_level_instance_name>/CORERESETP_0/SDIF*_PSEL\
<top_level_instance_name>/CORERESETP_0/SDIF*_PWRITE\
<top_level_instance_name>/CORERESETP_0/SDIF*_PRDATA[*]\
<top_level_instance_name>/CORERESETP_0/SOFT_EXT_RESET_OUT \
<top_level_instance_name>/CORERESETP_0/SOFT_RESET_F2M\
<top_level_instance_name>/CORERESETP_0/SOFT_M3_RESET \
<top_level_instance_name>/CORERESETP_0/SOFT_MDDR_DDR_AXI_S_CORE_RESET \
<top_level_instance_name>/CORERESETP_0/SOFT_FDDR_CORE_RESET\
<top_level_instance_name>/CORERESETP_0/SOFT_SDIF*_PHY_RESET \
<top_level_instance_name>/CORERESETP_0/SOFT_SDIF*_CORE_RESET \
<top_level_instance_name>/CORERESETP_0/SOFT_SDIF0_0_CORE_RESET\
<top_level_instance_name>/CORERESETP_0/SOFT_SDIF0_1_CORE_RESET}]

set_max_delay 0 -through [get_nets {\
<top_level_instance_name>/CORECONFIGP_0/FIC_2_APB_M_PSEL\
<top_level_instance_name>/CORECONFIGP_0/FIC_2_APB_M_PENABLE}] -to [get_cells {\
<top_level_instance_name>/CORECONFIGP_0/FIC_2_APB_M_PREADY*\
<top_level_instance_name>/CORECONFIGP_0/state[0]}]

set_min_delay -24 -through \
[get_nets {<top_level_instance_name>/CORECONFIGP_0/FIC_2_APB_M_PWRITE\
<top_level_instance_name>/CORECONFIGP_0/FIC_2_APB_M_PADDR[*]\
<top_level_instance_name>/CORECONFIGP_0/FIC_2_APB_M_PWDATA[*]\
<top_level_instance_name>/CORECONFIGP_0/FIC_2_APB_M_PSEL\
<top_level_instance_name>/CORECONFIGP_0/FIC_2_APB_M_PENABLE}]

```

## PDC Physical Design Constraints

For the Libero SoC Enhanced Constraint Flow, this top-level PDC constraint file is available from the Constraint Manager (**Design Flow > Open Manage Constraint View > Timing > Derive Constraints**). Modify, if necessary, the full hierarchical path and design object names to match the names used in your design.

*Note: This file is NOT generated for the Classic Constraint Flow, even if your design contains the CoreConfigP component. Refer to this file to set the PDC constraints for the CoreConfigP component. Modify the full hierarchical path, if necessary, to match your design hierarchy. Save the \*.pdc file to a different name. Import the PDC file to your project and use it for Compile, just like any other PDC constraint files.*

### <top\_level>\_derived\_constraints.pdc (Generated in Enhanced Constraint Flow only)

This PDC design constraint file creates a region specifically for the CoreConfigP IP Core and places the core in the region created. This constrains the Place and Route engine to place the core in an optimal location resulting in better timing performance of the design when routed. For the Enhanced Constraint Flow project, the full hierarchical path from the top is given for the constraint. Modify, if necessary, the hierarchical path to match the names in your design.

```

# Microsemi Corp.
# Date: 2016-Aug-08 11:49:33
# This file was generated based on the following PDC source files:
# W:/pc/11_7_1_14_lily/Designer/data/ap4M/cores/constraints/PA4M12000/

```



```
# coreconfigp.pdc
#

define_region -name {auto_coreconfigp} -type inclusive 1104 159 1451 299
assign_region {auto_coreconfigp} {<top_level_instance_name>/CORECONFIGP_0}
```

---

## C – Product Support

---

Microsemi SoC Products Group backs its products with various support services, including Customer Service, Customer Technical Support Center, a website, electronic mail, and worldwide sales offices. This appendix contains information about contacting Microsemi SoC Products Group and using these support services.

### Customer Service

Contact Customer Service for non-technical product support, such as product pricing, product upgrades, update information, order status, and authorization.

From North America, call **800.262.1060**

From the rest of the world, call **650.318.4460**

Fax, from anywhere in the world, **650.318.8044**

### Customer Technical Support Center

Microsemi SoC Products Group staffs its Customer Technical Support Center with highly skilled engineers who can help answer your hardware, software, and design questions about Microsemi SoC Products. The Customer Technical Support Center spends a great deal of time creating application notes, answers to common design cycle questions, documentation of known issues, and various FAQs. So, before you contact us, please visit our online resources. It is very likely we have already answered your questions.

### Technical Support

For Microsemi SoC Products Support, visit <http://www.microsemi.com/products/fpga-soc/design-support/fpga-soc-support>.

### Website

You can browse a variety of technical and non-technical information on the Microsemi SoC Products Group home page, at [www.microsemi.com/soc](http://www.microsemi.com/soc).

### Contacting the Customer Technical Support Center

Highly skilled engineers staff the Technical Support Center. The Technical Support Center can be contacted by email or through the Microsemi SoC Products Group website.

#### Email

You can communicate your technical questions to our email address and receive answers back by email, fax, or phone. Also, if you have design problems, you can email your design files to receive assistance. We constantly monitor the email account throughout the day. When sending your request to us, please be sure to include your full name, company name, and your contact information for efficient processing of your request.

The technical support email address is [soc\\_tech@microsemi.com](mailto:soc_tech@microsemi.com).

## My Cases

Microsemi SoC Products Group customers may submit and track technical cases online by going to My Cases.

## Outside the U.S.

Customers needing assistance outside the US time zones can either contact technical support via email ([soc\\_tech@microsemi.com](mailto:soc_tech@microsemi.com)) or contact a local sales office.

Visit [About Us](#) for sales office listings and corporate contacts.

Sales office listings can be found at [www.microsemi.com/soc/company/contact/default.aspx](http://www.microsemi.com/soc/company/contact/default.aspx).

## ITAR Technical Support

For technical support on RH and RT FPGAs that are regulated by International Traffic in Arms Regulations (ITAR), contact us via [soc\\_tech\\_itar@microsemi.com](mailto:soc_tech_itar@microsemi.com). Alternatively, within My Cases, select **Yes** in the ITAR drop-down list. For a complete list of ITAR-regulated Microsemi FPGAs, visit the ITAR web page.



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