XPack™ Guide for AMBA IP

Confidential – Under NDA
IPextreme®, Inc.
Document Version 1.0.5
December 21, 2010

Printed in the USA

IPextreme, Inc.
54 North Central Ave.
Suite 204
Campbell, CA 95008
www.ip-extreme.com

TABLE OF CONTENTS

PREFACE

The National Semiconductor IP Library for AMBA Interconnect (referred to hereafter as the AMBA IP Library) is a collection of IP blocks from National Semiconductor that are available as fully sythesizable IP from IPextreme. Each IP block (referred to hereafter as component) connects to an AMBA 2 AHB or APB.

Each component is delivered in the form of an IPextreme product XPack that you download from the IPextreme IP Distribution and Support Portal. Each AMBA IP Library component XPack includes synthesizable source code for the component, an integration testbench, and scripts to simulate and synthesize the component using your preferred tools.

This manual describes how to configure, download, simulate, and synthesize individual AMBA IP Library components.

Intended Audience

This manual is intended for chip designers who are integrating one or more AMBA IP Library components into an ASIC or FPGA design or evaluating AMBA IP Library components for use in an ASIC or FPGA design. Readers of this manual are expected to be familiar with chip design technology and electronic design automation (EDA) tools.

Document Organization

This manual is organized as follows:

- Chapter 1: Getting Started presents an overview of the IPextreme IP Distribution and Support Portal and XPack tools.
- Chapter 2: Configure and Download describes how to use the IPextreme IP Distribution and Support Portal to configure and download an AMBA IP Library component.
- Chapter 3: Simulation describes the general procedure for running a simulation with an AMBA IP Library component integration testbench.
- Chapter 4: Synthesis describes how to synthesize an AMBA IP Library component.
- Chapter 5: Integration provides information to instantiate an AMBA IP Library component.

Related Documentation

This manual provides XPack-related information that is common to all AMBA IP Library components. For details about an individual component, including configuration parameters, top-level signal and interface descriptions, and testbench description, refer to the Integration Guide for that component.

Getting Help

To get help with AMBA IP Library components, send e-mail to support@ip-extreme.com.

If you are an IPextreme customer with a current support contract, log on to the IPextreme IP Distribution and Support Portal at https://xpack.ip-extreme.com.

For information about IPextreme and IPextreme products, go to www.ip-extreme.com.

CHAPTER 1
GETTING STARTED

Working with AMBA IP Library components involves tasks that you perform through the IPextreme IP Distribution and Support Portal and tasks that you perform in your own environment.

Using your web browser, you log on to the IPextreme IP Distribution and Support Portal to:

1. Configure the component according to your design requirements.
2. View and adjust synthesis constraints.
3. Select a synthesis tool and an example technology library.
4. Download the AMBA IP Library component XPack to your local environment.

The downloaded product XPack includes:

- Synthesizable source code for the component
- Synthesis scripts
- For most AMBA IP Library components: an integration testbench, test programs, and simulation scripts
- Documentation: Documentation Guide, Integration Guide, User Guide, Release Note, and a copy of this document, the *XPack Guide for AMBA IP.* Additionally, the *XPack User Guide,* which provides detailed information about working with the IPextreme IP Distribution and Support Portal and XPack tools, is available from the Help link at https://xpack.ip-extreme.com.

After downloading the product XPack to your local environment, you can:

1. Install the downloaded AMBA IP Library component XPack into a local directory.
2. Simulate the component's integration testbench with your preferred simulation tool.
3. Synthesize the component.
4. Integrate the component and the supplied constraint scripts into your chip-level design and implementation flow, respectively.

As shown in Figure 1, the preferred method for running simulation and synthesis in your local environment is to use your local installation of the IPextreme XPack tools. The XPack tools provide a common set of commands to automate tasks such as simulation and synthesis for any core that you download from the IPextreme IP Distribution and Support Portal. However, if you prefer not to install and use the XPack tools, you can use the provided UNIX shell scripts for simulation and synthesis.

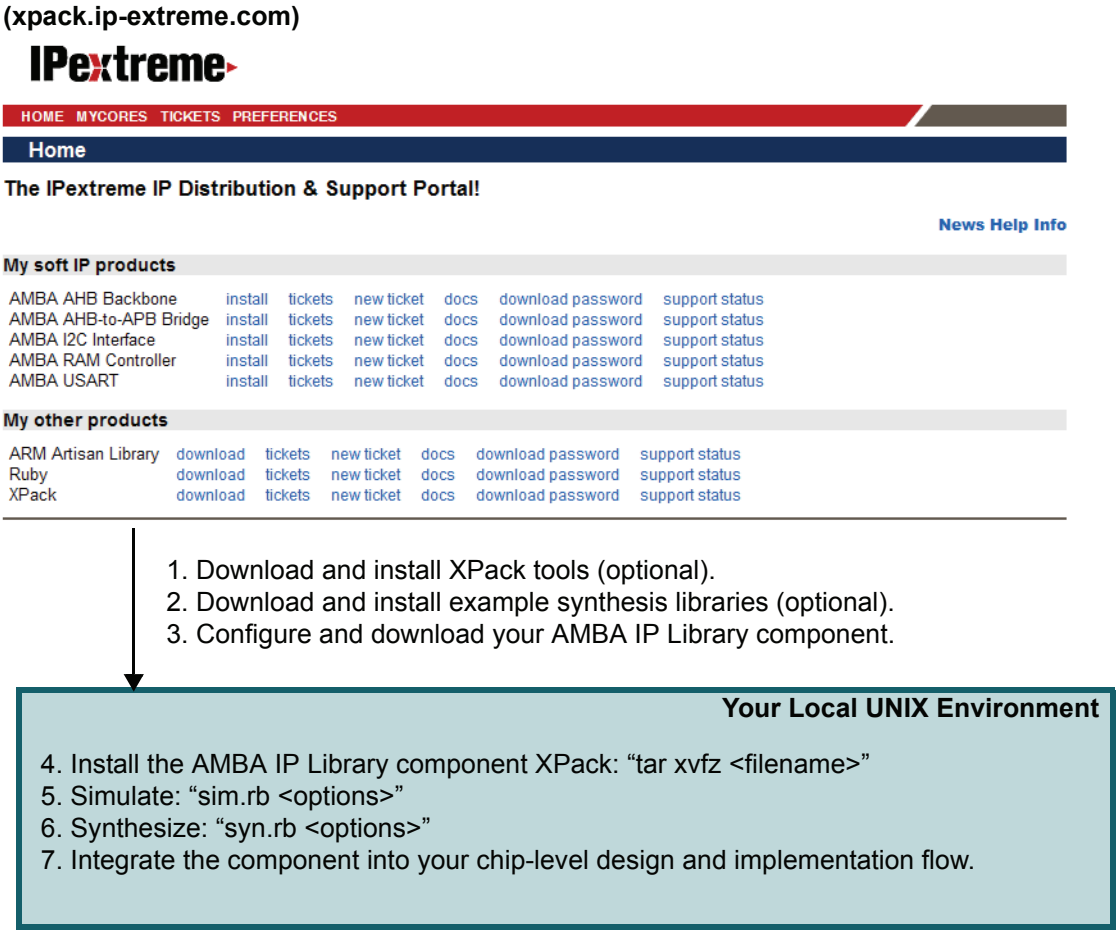

FIGURE 1: BASIC XPACK WORKFLOW

Checking System and Tool Requirements

To access, download, and work with the AMBA IP Library components, you will need the following resources:

- To access the IPextreme IP Distribution and Support Portal, you will need an Internet connection, web browser, user ID, and password.
- To create a workspace for the AMBA IP Library, you will need a project name.
- To download the configured AMBA IP Library XPack, you will need your download password.

- To install the AMBA IP Library XPack, you will need:
  - A supported Linux or Solaris based workstation
  - Approximately 20 MB of disk space
- For simulation, you will need a supported simulation tool.
- For synthesis, you will need a supported synthesis tool.
- For automated simulation and synthesis using the XPack tools, you will need the following items (available from the IPextreme IP Distribution and Support Portal):
  - XPack tools
  - Ruby
  - ARM Artisan libraries (required to synthesize the AMBA IP Library IP with your selected example library)—the ARM Artisan libraries are only available if you have signed the required End User License Agreement (EULA)

For details regarding the supported platform, operating system, and EDA tool versions, refer to the Release Note for your selected component.

For XPack tool installation and setup instructions, refer to the *XPack User Guide*.

NOTE: The remainder of this manual focuses specifically on working with an AMBA IP Library component XPack. For complete information about the IPextreme IP Distribution and Support Portal and XPack tools, including advanced features, refer to the *XPack User Guide*. You can access the *XPack User Guide* by clicking the Help button after logging in to https://xpack.ip-extreme.com.

CHAPTER 2
CONFIGURE AND DOWNLOAD

Configuring and downloading an AMBA IP Library component involves the following tasks:

- Creating a Workspace for the AMBA IP Library component on the IPextreme IP Distribution and Support Portal
- Configuring the Component
- Viewing and Adjusting Constraints
- Viewing Timing Exceptions
- Reviewing Your Setup
- Creating the XPack Tarfile
- Downloading the XPack Tarfile
- Installing the XPack Tarfile on your local disk

Creating a Workspace

The first step in working with an AMBA IP Library component on the IPextreme IP Distribution and Support Portal is to create a user configuration workspace for the component:

1. Using your web browser, go to https://xpack.ip-extreme.com and log in using your user ID and password.
2. In the IPextreme IP Distribution and Support Portal HOME view, click the “install” button next to the name of the AMBA IP Library component under “My soft IP products”.
3. In the Installation view:
   - Select a project (if more than one project is available).
   - Select a release of the AMBA IP Library component (typically the most recent unless you have a reason to install an older release).
   - Enter a name for your configuration.
   - Click the “Install” button.

The IPextreme IP Distribution and Support Portal creates your workspace and takes you to the PARAMETERS view of the newly created workspace.

When you are in your workspace, there is an additional navigation bar with workspace-specific menu options (PARAMETERS, CONSTRAINTS, and so on). Clicking the “Save” button stores any changes you make. Selecting MYCORES takes you out of the current workspace and into your MYCORES view where you can:

- Return the workspace you just created.
- Go to any other workspace that you previously created.
- Create another workspace.
- Delete a workspace that is no longer needed.

Configuring the Component

In the PARAMETERS view of your workspace, select values for your selected AMBA IP Library component’s configuration parameters. Refer to the Integration Guide for the component for detailed definitions of the available parameters.

After selecting your parameter values, click “Save” to store your selections.

Viewing and Adjusting Constraints

In the CONSTRAINTS view of your workspace, you can view and adjust the values of the timing constraints for synthesis. Refer to the component’s Integration Guide for definitions of clocks and I/O signals and any component-specific guidelines regarding constraints and synthesis. For general information about specifying constraints through the IPextreme IP Distribution and Support Portal, refer to the *XPack User Guide*.

NOTE: For components that implement local clock gating, there are setup and hold check related parameters in the PARAMETERS view on the IPextreme IP Distribution and Support Portal. The setup and hold check parameters are used for synthesis script generation and are not actual hardware configuration parameters. For additional details about clock gating setup and hold timing checks, refer to the component’s Integration Guide and the Clock Gating Checks section of the *XPack User Guide*.

When you are finished reviewing and/or editing the constraints, click “Save” to store your changes.

NOTE: Clocks that are defined but are not top-level signals appear in the CLOCKS page of your workspace.

Viewing Timing Exceptions

The EXCEPTIONS view of your workspace lists the timing exceptions that will be included in the synthesis scripts for the component. For some components, there are no timing exceptions. The timing exceptions (if any exist) are shown in the EXCEPTIONS page for your information only. You do not need to modify the timing exceptions.

Reviewing Your Setup

You can review your configuration and clock setup specifications in the SUMMARY view of your workspace.

Creating the XPack Tarfile

To generate your synthesis scripts and build your download package (the AMBA IP Library component XPack), go to the DOWNLOAD view. In the DOWNLOAD view, you can choose from the supported synthesis tools and example synthesis libraries. (The libraries must be downloaded separately as described in the *XPack User Guide*.)

NOTE: To download a Windows-compatible version of the AMBA IP Library XPack (with no UNIX-style links between files), select the “Create tarfile for Windows (no UNIX links)” option.

When you click the “Create” button, the IPextreme IP Distribution and Support Portal generates your synthesis scripts and builds a tarfile of the entire AMBA IP Library XPack. When the build completes, a file of summary information appears.

Downloading the XPack Tarfile

After building your XPack:

1. Click DOWNLOAD again to return to the DOWNLOAD view.
2. Enter your download password number to enable the download.
3. Click the “Download” button to initiate the download.

   Your browser prompts you for a location to store the generated tarfile on your local disk.
4. Choose a location and save the tarfile.

At this point (or at any point you like), you can exit the IP Distribution and Support Portal. You can return to the IP Distribution and Support Portal at any time to make any necessary changes to your workspace. After making changes, you will need to create and download a new tarfile. Subsequent builds of the tarfile will include the complete workspace. You can also create a new workspace to experiment with a different component configuration.

Installing the XPack Tarfile

After saving the XPack tarfile, you can unpack (install) it anywhere on your local disk. The installation procedure depends on whether you are installing on a UNIX or Windows system.

Installing for UNIX

To install the AMBA IP Library component XPack on a UNIX (Linux or Solaris) platform, make sure that your UNIX paths are set up to execute GNU tar when you enter the tar command, then install the XPack as follows:

```
% cd <my_work_path>
% tar xvfz <tarfile>
```

Figure 2 shows the directory structure of your installed AMBA IP Library component XPack. The remainder of this manual describes how to navigate those directories to perform simulation, synthesis, and integration related tasks.

Throughout the remainder of this document, the directory name <install_dir> corresponds to <my_work_path>/<string>-<component>-r<release> as shown in Figure 2.

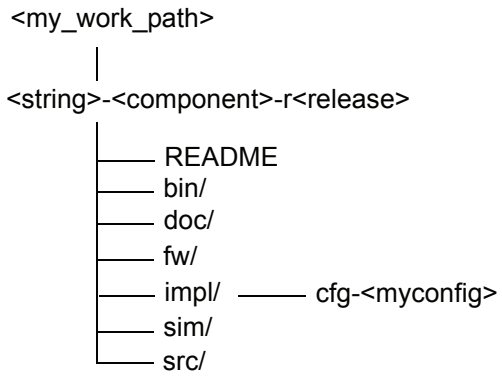

FIGURE 2: DIRECTORY STRUCTURE OF AMBA IP LIBRARY COMPONENT XPACK INSTALLATION

Installing for Windows

Although your AMBA IP Library component XPack does not include an automated flow for Windows-based EDA tools, you can install the AMBA IP Library component XPack on a Windows system and extract the component's source files to use in your own Windows-based development environment. To do so, use a Windows tarfile extraction utility (for example, WinZip) to open the downloaded tarfile. Extract all files and folders to maintain the XPack directory structure (see Figure 2).

After you have extracted all files and folders from the tarfile to a destination folder on your PC, the contents of that folder will be as shown in Figure 2. The source files for your selected component configuration are in <install_dir>/impl/cfg-<myconfig>/src. The file <install_dir>/impl/cfg-<myconfig>/filelist.txt contains a list of all files that must be compiled to synthesize the component.

NOTE: If you did not choose the “Create tarfile for Windows (no UNIX links)” option when you created the tarfile on the IPextreme IP Distribution and Support Portal, the folders under <install_dir>/impl/cfg-<myconfig>/src contain UNIX-style links to files located in other folders (src and modules). If that occurs, you can return to the DOWNLOAD view for your workspace on the IPextreme IP Distribution and Support Portal and choose “Create tarfile for Windows (no UNIX links)” to create and download a new Windows-compatible tarfile.

CHAPTER 3
SIMULATION

Most AMBA IP Library component packages include a simulation environment that demonstrates how to integrate the component into a system testbench, check the top-level connections, and stimulate the top-level interfaces. A set of test programs exercise various functions and interfaces.

The integration testbench is not intended to serve as a full functional verification environment. Rather, it is intended to demonstrate the functional behavior of the component and its top-level interfaces. You can use the integration testbench as an example to integrate the component into your system functional verification environment.

The structure of the integration testbench and the functions of its test programs are specific to the component and are described in the component's Integration Guide. However, the simulation procedure is the same for all AMBA IP Library components. After you download and install the AMBA IP Library XPack, you can run simulation in your local environment using either of the following methods:

- Run the simulation with the sim.rb command (available if you have installed the XPack tools)
- Run the simulation with the UNIX scripts (can be used if you have not installed the XPack tools or as an alternative to sim.rb)

Running the Simulation with sim.rb

To run the simulation with sim.rb:

1. Go to the sim directory:

   ```
   % cd <install_dir>/sim
   ```

2. Invoke sim.rb with the options required to select your HDL simulation tool and to select which test(s) to run. For example, to run a single test named tp-mytest in batch mode, enter:

   ```
   % sim.rb -b -t tp-mytest -s <simulator>
   ```

   <simulator> can be vcs, ncverilog, or modelsim.

To run tp-mytest interactively, enter:

```
% sim.rb -t tp-mytest -s <simulator>
```

NOTE: tp-mytest is an example test name. Refer to the component's Integration Guide for the test names associated with that component.

To run all available integration tests (regression), enter:

```
% sim.rb -r -s <simulator>
```

At the completion of test execution, the test prints a pass/fail message to your screen and one or more simulation log files are available for viewing, as described in the component's Integration Guide. For more information about using sim.rb, refer to the *XPack User Guide* or enter sim.rb -h to display a help message.

Simulating with UNIX Run Scripts

Instead of using sim.rb, you can use one of the run_<simulator>.sh scripts located in the run directory of the test you want to run (<install_dir>/sim/work/tp-<test_name>). You can use the run_<simulator>.sh scripts even if you have not installed the XPack tools as described in the *XPack User Guide*.

<simulator> can be vcs, ncverilog, or modelsim. For example, to run test tp-mytest with Synopsys VCS using the appropriate UNIX shell script, execute the following commands:

```
% cd <install_dir>/sim/work/tp-mytest
% run_vcs.sh
```

The run script starts the selected simulator in interactive mode.

Component Configuration for Simulation

The AMBA IP Library IP component configuration used for simulation is defined in the configuration file for the test program that you are running and is independent of the component configuration that you choose on the IPextreme IP Distribution and Support Portal. Refer to the component's Integration Guide for component-specific configuration information.

CHAPTER 4
SYNTHESIS

After you download your AMBA IP Library component from the IPextreme IP Distribution and Support Portal (with your synthesis setup already configured), you have several options for synthesis. If you have installed the XPack tools, Ruby, and the example technology libraries, you can quickly run synthesis in your local environment by using syn.rb as follows:

1. Refer to the component's Integration Guide for any special information regarding synthesis of that component.
2. Go to the synthesis directory:

   ```
   % cd <install_dir>/impl/cfg-<myconfig>/syn/<tool>
   ```

3. Invoke syn.rb with your selected option(s):
   - To simply generate scripts and run the synthesis with no options selected:

     ```
     % syn.rb
     ```

   - If you want to preserve the instance names of generic cells as described in "Preserving Instance Names of Generic Cells" on page 20, you need to modify the synthesis flow. To do so, first run syn.rb with the -s option to generate synthesis scripts without executing them:

     ```
     % syn.rb -s
     ```

     Then, modify the compile script for your selected synthesis tool as described in "Preserving Instance Names of Generic Cells" on page 20. After modifying the compile script, run syn.rb with the -r option to execute your modified compile script:

     ```
     % syn.rb -r
     ```

     The above command executes a synthesis run for the component using your selected example technology library.

NOTE: Running syn.rb without any options generates and executes the synthesis scripts, overwriting any customizations you may have made to the scripts. To use your modified compile script, you must use "syn.rb -r".

Other options for synthesis include:

- Importing the generated constraint script into your chip-level synthesis environment
- Using syn.rb options to customize synthesis execution

- Using the supplied UNIX shell script to synthesize the component
- Synthesizing the component with your own custom technology library

For any of the above options, follow the procedures in the *XPack User Guide*. The *XPack User Guide* is available from the Help link at https://xpack.ip-extreme.com.

Preserving Instance Names of Generic Cells

The RTL code of each AMBA IP Library component references one or more generic cells such as inverter, nand2, multiplexer, and buffer. These cells, listed in Table 1, are described in a technology-independent format. However, you may want to preserve the instance names of the instantiated cells during synthesis, particularly if the cells are instantiated in clock gating logic.

TABLE 1: LIST OF INSTANTIATED CELLS

Instantiated Cells
buf_gea1
inv_gea1
mux_n2x1_gea0
mux_n4x2_aua0
nand2_gea1
and2_gea0
or2_gea
nor2_gea1

NOTE: For details about how these generic cells are instantiated within a specific component, refer to the component's Integration Guide.

The instance names of the generic cells are "phmul_<name>". To preserve the instance names in the synthesized netlist (for example, to find the cells during layout), you must make sure that the cells are marked "dont_touch" or not ungrouped during the synthesis run. To do so, modify the compile script generated by the "syn.rb -s" command before resuming synthesis with the "syn.rb -r" command.

The generated compile script is:

<install_dir>/impl/cfg-<myconfig>/syn/<tool>/scr/compile.tcl

The commands that you must add to compile.tcl are provided in the <install_dir>/example directory:

- For Design Compiler, insert the commands contained in the file do_not_ungroup_generic_cells_dcxg.tcl immediately before the "compile -ultra" command in compile.tcl.
- For RTL Compiler, insert the commands contained in the file do_not_ungroup_generic_cells_rc.tcl immediately before the "synthesize" command in compile.tcl.

CHAPTER 5
INTEGRATION

To instantiate an AMBA IP Library component in your application design or testbench, refer to:

- The component's Integration Guide for functional descriptions of the component's top-level ports
- The example instantiation in the integration testbench top-level file: <install_dir>/sim/tb/<testbench_filename>.v

You will also need to modify your simulation or synthesis file list to include the component's design files. For a list of all source files that must be compiled to synthesize the component, see <install_dir>/impl/cfg-<myconfig>/filelist.txt.

The source files for your configuration of the AMBA IP Library IP are in the directory <install_dir>/impl/cfg-<myconfig>/src/.

If you chose the "Create tarfile for Windows (no UNIX links)" download option on the IPextreme IP Distribution and Support Portal, then all of the source files for your configuration of the AMBA IP Library component are in <install_dir>/impl/cfg-<myconfig>/src/ with no UNIX-style links to files located in <install_dir>/src.

If you did not chose the "Create tarfile for Windows (no UNIX links)" download option on the IPextreme IP Distribution and Support Portal Files, then the files that are not specific to your component's configuration are links to the corresponding files in <install_dir>/src.