

BFM Simulation in Platform Studio

This document describes Bus Functional Model (BFM) simulation within Xilinx® Platform Studio. The following topics are included:

- [“Introduction”](#)
- [“Bus Functional Simulation Basics”](#)
- [“Bus Functional Model Use Cases”](#)
- [“Bus Functional Simulation Methods”](#)
- [“Getting and Installing the Platform Studio BFM Package”](#)
- [“Using the Platform Studio BFM Package”](#)

Note: BFM simulation can be run with ModelSim only.

Introduction

Bus Functional Simulation provides the ability to generate bus stimulus and thereby simplifies the verification of hardware components that attach to a bus. Bus Functional Simulation circumvents the drawbacks to the two typical validation methods, which are:

- **Creating a test bench:** This is time-consuming because it involves describing the connections and test vectors for all combinations of bus transactions.
- **Creating a larger system with other known-good components that create or respond to bus transactions:** This is time-consuming because it requires that you describe the established connections to the device under test, program the added components to generate the bus transactions to which the device will respond, and potentially respond to bus transactions that the device is generating. Such a system usually involves creating and compiling code, storing that code in memory for the components to read, and generating the correct bus transactions.

© Copyright 2002 - 2009 Xilinx, Inc. All Rights Reserved.

XILINX, the Xilinx logo, the Brand Window and other designated brands included herein are trademarks of Xilinx, Inc.

The PowerPC name and logo are registered trademarks of IBM Corp., and used under license. All other trademarks are the property of their respective owners.

Xilinx is disclosing this user guide, manual, release note, and/or specification (the "Documentation") to you solely for use in the development of designs to operate with Xilinx hardware devices. You may not reproduce, distribute, republish, download, display, post, or transmit the Documentation in any form or by any means including, but not limited to, electronic, mechanical, photocopying, recording, or otherwise, without the prior written consent of Xilinx. Xilinx expressly disclaims any liability arising out of your use of the Documentation. Xilinx reserves the right, at its sole discretion, to change the Documentation without notice at any time. Xilinx assumes no obligation to correct any errors contained in the Documentation, or to advise you of any corrections or updates. Xilinx expressly disclaims any liability in connection with technical support or assistance that may be provided to you in connection with the Information. THE DOCUMENTATION IS DISCLOSED TO YOU "AS-IS" WITH NO WARRANTY OF ANY KIND. XILINX MAKES NO OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED, OR STATUTORY, REGARDING THE DOCUMENTATION, INCLUDING ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NONINFRINGEMENT OF THIRD-PARTY RIGHTS. IN NO EVENT WILL XILINX BE LIABLE FOR ANY CONSEQUENTIAL, INDIRECT, EXEMPLARY, SPECIAL, OR INCIDENTAL DAMAGES, INCLUDING ANY LOSS OF DATA OR LOST PROFITS, ARISING FROM YOUR USE OF THE DOCUMENTATION.

Bus Functional Simulation Basics

Bus Functional Simulation usually involves the following components:

- A Bus Functional Model
- A Bus Functional Language
- A Bus Functional Compiler

Bus Functional Models (BFMs)

BFMs are hardware components that include and model a bus interface. There are different BFMs for different buses. For example, there are OPB BFM components and PLB BFM components. Each is used to connect to its own respective bus.

For each bus, there are different model types. For example the OPB bus has OPB Master, OPB Slave, and OPB Monitor BFM components. The same set of components and more could exist for other busses, or the functionality of BFM components could be combined into a single model.

Bus Functional Language (BFL)

The BFL describes the behavior of the BFM components. You can specify how to initiate or respond to bus transactions using commands in a BFL file.

Bus Functional Compiler (BFC)

The BFC translates a BFL file into the commands that actually program the selected Bus Functional Model.

Bus Functional Model Use Cases

There are two main use cases for Bus Functional Models: IP verification and speed-up simulation

IP Verification

When verifying a single piece of IP that includes a bus interface you concern yourself with the internal details of the IP design and the bus interactions. It is inefficient to attach the IP to a large system only to verify that it is functioning properly.

The following figure shows an example in which a master BFM generates bus transactions to which the device under test responds. The monitor BFM reports any errors regarding the bus compliance of the device under test.

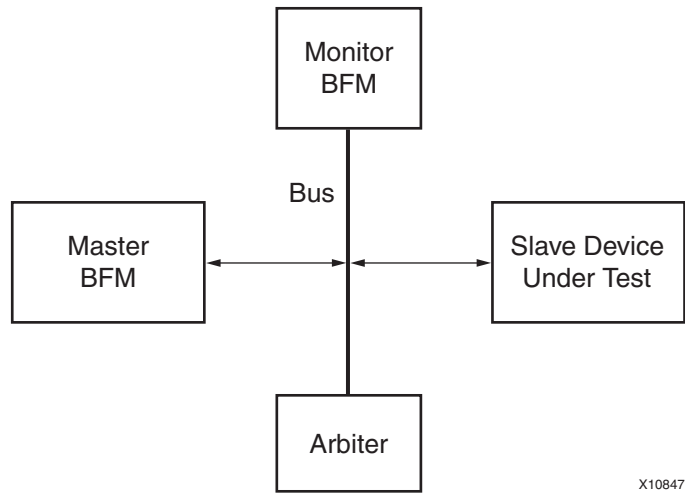


Figure 1: **Slave IP Verification Use Case**

The following figure shows an example in which a slave BFM responds to bus transactions that the device under test generates. The monitor BFM reports any errors regarding the bus compliance of the device under test.

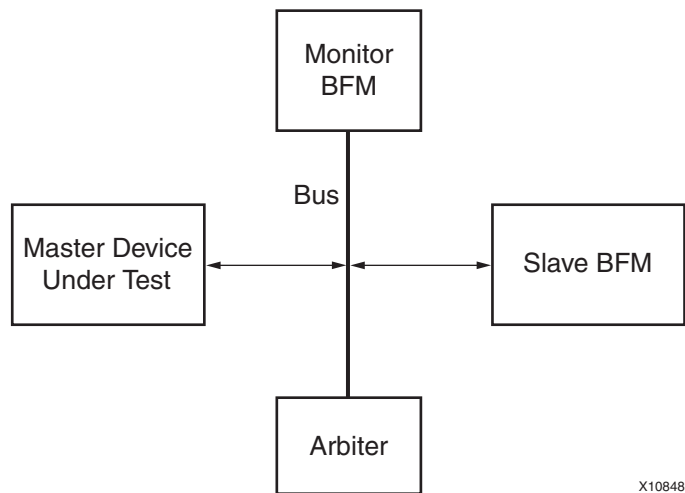


Figure 2: **Master IP Verification Use Case**

Speed-Up Simulation

When verifying a large system design, it can be time consuming to simulate the internal details of each IP component that attaches to a bus. There are certain complex pieces of IP that take a long time to simulate and could be replaced by a Bus Functional Model, especially when the internal details of the IP are not of interest. Additionally, some IP components are not easy to program to generate the desired bus transactions.

The following figure shows how two different IP components that are bus masters have been replaced by BFM master modules. These modules are simple to program and can provide a shorter simulation time because no internal details are modeled.

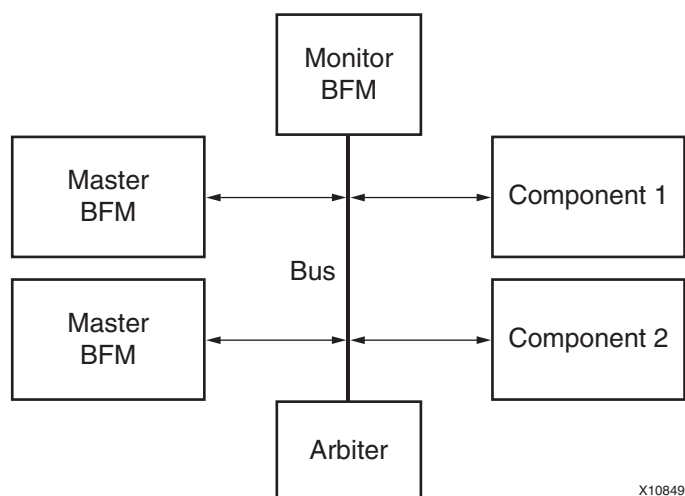


Figure 3: Speed-Up Simulation Use Case

Bus Functional Simulation Methods

There are two software packages that allow you to perform Bus Functional Simulation, and each applies its own methodology:

- IBM® CoreConnect™ Toolkit
- Xilinx® EDK BFM Package

Neither software package is included with EDK, but they are required if you intend to perform bus functional simulation. You can download them free of charge once you obtain a license for the IBM CoreConnect Bus Architecture. Licensing CoreConnect provides access to a wealth of documentation, Bus Functional Models, and the Bus Functional Compiler.

Xilinx provides a Web-based licensing mechanism that enables you to obtain CoreConnect from the Xilinx web site. To license CoreConnect, use an internet browser to access: http://www.xilinx.com/products/ipcenter/dr_pcentral_coreconnect.htm. Once the request has been approved (typically within 24 hours), you will receive an E-mail granting you access to the protected web site from which to download the toolkit.

For further documentation on the CoreConnect Bus Architecture, refer to the IBM CoreConnect web site:

http://www-01.ibm.com/chips/techlib/techlib.nsf/products/CoreConnect_Bus_Architecture

Note: There are some differences between IBM CoreConnect and the Xilinx implementation of CoreConnect. These are described in the *Processor IP Reference Guide*, available in your `$XILINX_EDK/doc/usenglish` directory. Refer to the following sections: “On-Chip Peripheral Bus V2.0 with OPB Arbiter” for differences in the OPB bus, “Processor Local Bus (PLB) V3.4” for differences in the PLB bus, and “Device Control Register Bus (DCR) V2.9” for differences in the DCR bus.

IBM CoreConnect Toolkit

The IBM CoreConnect Toolkit is a collection of three toolkits:

- OPB Toolkit
- PLB Toolkit
- DCR Toolkit

Each toolkit includes a collection of HDL files that represents predefined systems, including a bus, bus masters, bus slaves, and bus monitors.

You can modify the predefined systems included in the toolkits manually to connect the hardware components you want to test. This is a labor-intensive process because you must describe all the connections to the bus and ensure there are no errors in setting up the test environment.

Refer to the CoreConnect Toolkit documentation for more information on how to verify your hardware module.

Platform Studio BFM Package

The Platform Studio BFM package includes a set of CoreConnect BFM, the Bus Functional Compiler, and CoreConnect documents tailored for use within Platform Studio. The BFM package lets you specify bus connections from a high-level description, such as an MHS file. By allowing the Platform Studio tools to write the HDL files that describe the connections, the time and effort required to set up the test environment are reduced.

The following sections describe how to perform BFM simulation using the Platform Studio BFM Package.

Getting and Installing the Platform Studio BFM Package

The use of the CoreConnect BFM components requires the acceptance of a license agreement. For this reason, the BFM components are not installed along with EDK. Xilinx provides a separate installer for these called the “Xilinx EDK BFM Package.”

To use the Xilinx EDK BFM Package, you must register and obtain a license to use the IBM CoreConnect Toolkit at:

http://www.xilinx.com/products/ipcenter/dr_pcentral_coreconnect.htm

After you register, you receive instructions and a link to download the CoreConnect Toolkit files. You can then install the files using the registration key provided.

After running the installer, you can verify that the files were installed by typing the following command:

```
xilbfc -check
```

The **Success!** message indicates you are ready to continue; otherwise, you will receive instructions on the error.

Using the Platform Studio BFM Package

After successfully downloading and installing the Platform Studio BFM Package, you can launch Platform Studio. The components are listed in the **Add/Edit Cores** dialog box.

Note: OPB and PLB components are deprecated in the 11.1 release.

- OPB Device BFM (`opb_device_bfm`)
The OPB device model can act as a master, slave, or both. The master contains logic to initiate transactions on the bus automatically. The slave contains logic to respond to bus transactions based on an address decode operation. The model maintains an internal memory that can be initialized through the Bus Functional Language and can be checked dynamically during simulation or when all bus transactions are complete.
- OPB Monitor BFM (`opb_monitor_bfm`)
The OPB monitor is a model that connects to the OPB and continuously samples the bus signals. It checks for bus compliance or violations of the OPB architectural specifications and reports warnings and errors.
- PLB Master BFM (`plb_master_bfm`)
The PLB master model contains logic to initiate transactions on the bus automatically. The model maintains an internal memory that can be initialized through the Bus Functional Language and can be checked dynamically during simulation or when all bus transactions are complete.
- PLB Slave BFM (`plb_slave_bfm`)
The PLB slave contains logic to respond to bus transactions, based on an address decode operation. The model maintains an internal memory that can be initialized through the Bus Functional Language and may be dynamically checked during simulation or when all bus transactions have completed.
- PLB Monitor (`plb_monitor_bfm`)
The PLB monitor is a model that connects to the PLB and continuously samples the bus signals. It checks for bus compliance or violations of the PLB architectural specifications and reports warnings and errors.
- PLB v4.6 Master BFM (`plbv46_master_bfm`)
The PLB v4.6 master model contains logic to initiate bus transactions on the PLB v4.6 bus automatically. The model maintains an internal memory that can be initialized through the Bus Functional Language and may be dynamically checked during simulation or when all bus transactions have completed.
- PLB v4.6 Slave BFM (`plbv46_slave_bfm`)
The PLB v4.6 slave contains logic to respond to PLB v4.6 bus transactions based on an address decode operation. The model maintains an internal memory that can be initialized through the Bus Functional Language and may be dynamically checked during simulation or when all bus transactions have completed.

- PLB v4.6 Monitor (plbv46_monitor_bfm)
The PLB v4.6 monitor is a model that connects to the PLB v4.6 and continuously samples the bus signals. It checks for bus compliance or violations of the PLB v4.6 architectural specifications and reports warnings and errors.
- BFM Synchronization Bus (bfm_synch)
The BFM Synchronization Bus is not a bus BFM but a simple bus that connects BFMs in a design and allows communication between them. The BFM Synchronization Bus is required whenever BFM devices are used.

These components may be instantiated in an MHS design file for the Platform Studio tools to create the simulation HDL files.

Note: Xilinx has written an adaptation layer to connect the IBM CoreConnect Bus Functional Models to the Xilinx implementation of CoreConnect. Some of these BFM devices have different data/instruction bus widths.

OPB BFM Component Instantiation

The following is an example MHS file that instantiates OPB BFM components and the BFM synchronization bus.

```
# Parameters
PARAMETER VERSION = 2.1.0

# Ports
PORT rx = rx, DIR = IN
PORT tx = tx, DIR = OUT
PORT leds = leds, VEC = [0:7], DIR = INOUT
PORT sys_reset = sys_reset, DIR = IN
PORT sys_clk = sys_clk, DIR = IN, SIGIS = CLK

# Components
BEGIN opb_device_bfm
  PARAMETER INSTANCE = my_device
  PARAMETER HW_VER = 1.00.a
  PARAMETER SLAVE_ADDR_LO_0 = 0x00000000
  PARAMETER SLAVE_ADDR_HI_0 = 0x0000ffff
  PORT SYNCH_IN = synch
  PORT SYNCH_OUT = synch0
  BUS_INTERFACE MSOPB = opb_bus
END

BEGIN opb_monitor_bfm
  PARAMETER INSTANCE = my_monitor
  PARAMETER HW_VER = 1.00.a
  PORT OPB_Clk = sys_clk
  PORT SYNCH_IN = synch
  PORT SYNCH_OUT = synch1
  BUS_INTERFACE MON_OPB = opb_bus
END
```

```
BEGIN bfm_synch
  PARAMETER INSTANCE = my_synch
  PARAMETER HW_VER = 1.00.a
  PARAMETER C_NUM_SYNCH = 2
  PORT FROM_SYNCH_OUT = synch0 & synch1
  PORT TO_SYNCH_IN = synch
END
```

```
BEGIN opb_v20
  PARAMETER INSTANCE = opb_bus
  PARAMETER HW_VER = 1.10.b
  PARAMETER C_EXT_RESET_HIGH = 0
  PORT SYS_Rst = sys_reset
  PORT OPB_Clk = sys_clk
END
```

```
BEGIN opb_uartlite
  PARAMETER INSTANCE = my_uart
  PARAMETER HW_VER = 1.00.b
  PARAMETER C_DATA_BITS = 8
  PARAMETER C_CLK_FREQ = 100000000
  PARAMETER C_BAUDRATE = 19200
  PARAMETER C_USE_PARITY = 0
  PARAMETER C_BASEADDR = 0xffff0200
  PARAMETER C_HIGHADDR = 0xffff02ff
  BUS_INTERFACE SOPB = opb_bus
  PORT RX = rx
  PORT TX = tx
END
```

```
BEGIN opb_gpio
  PARAMETER INSTANCE = my_gpio
  PARAMETER HW_VER = 1.00.a
  PARAMETER C_GPIO_WIDTH = 8
  PARAMETER C_ALL_INPUTS = 0
  PARAMETER C_BASEADDR = 0xffff0100
  PARAMETER C_HIGHADDR = 0xffff01ff
  BUS_INTERFACE SOPB = opb_bus
  PORT GPIO_IO = leds
END
```

PLB BFM Component Instantiation

The following is an example MHS file that instantiates PLB BFM components and the BFM synchronization bus.

```
# Parameters
PARAMETER VERSION = 2.1.0

# Ports
PORT sys_clk = sys_clk, DIR = I, SIGIS = CLK
PORT sys_reset = sys_reset, DIR = IN

# Components
BEGIN plb_v34
  PARAMETER INSTANCE = myplb
  PARAMETER HW_VER = 1.01.a
  PARAMETER C_DCR_INTFCE = 0
  PORT PLB_Clk = sys_clk
  PORT SYS_Rst = sys_reset
END

BEGIN plb_bram_if_cntlr
  PARAMETER INSTANCE = myplb_bram_cntlr
  PARAMETER HW_VER = 1.00.a
  PARAMETER C_BASEADDR = 0xFFFFF8000
  PARAMETER C_HIGHADDR = 0xFFFFFFFF
  BUS_INTERFACE PORTA = porta
  BUS_INTERFACE SPLB = myplb
END

BEGIN bram_block
  PARAMETER INSTANCE = bram1
  PARAMETER HW_VER = 1.00.a
  BUS_INTERFACE PORTA = porta
END

BEGIN plb_master_bfm
  PARAMETER INSTANCE = my_master
  PARAMETER HW_VER = 1.00.a
  PARAMETER PLB_MASTER_ADDR_LO_0 = 0xFFFF0000
  PARAMETER PLB_MASTER_ADDR_HI_0 = 0xFFFFFFFF
  BUS_INTERFACE MPLB = myplb
  PORT SYNCH_OUT = synch0
  PORT SYNCH_IN = synch
END

BEGIN plb_slave_bfm
  PARAMETER INSTANCE = my_slave
  PARAMETER HW_VER = 1.00.a
  PARAMETER PLB_SLAVE_ADDR_LO_0 = 0xFFFF0000
  PARAMETER PLB_SLAVE_ADDR_HI_0 = 0xFFFF7FFF
  BUS_INTERFACE SPLB = myplb
  PORT SYNCH_OUT = synch1
  PORT SYNCH_IN = synch
END
```

```

BEGIN plb_monitor_bfm
  PARAMETER INSTANCE = my_monitor
  PARAMETER HW_VER = 1.00.a
  BUS_INTERFACE MON_PLB = myplb
  PORT SYNCH_OUT = synch2
  PORT SYNCH_IN = synch
END

BEGIN bfm_synch
  PARAMETER INSTANCE = my_synch
  PARAMETER HW_VER = 1.00.a
  PARAMETER C_NUM_SYNCH = 3
  PORT FROM_SYNCH_OUT = synch0 & synch1 & synch2
  PORT TO_SYNCH_IN = synch
END

```

PLB v4.6 BFM Component Instantiation

The following is an example MHS file that instantiates PLB v4.6 BFM components and the BFM synchronization bus.

```

# Parameters
PARAMETER VERSION = 2.1.0

# Ports
PORT sys_clk = sys_clk, DIR = I, SIGIS = CLK
PORT sys_reset = sys_reset, DIR = I

# Components
BEGIN plb_v46
  PARAMETER INSTANCE = myplb
  PARAMETER HW_VER = 1.04.a
  PARAMETER C_DCR_INTFCE = 0
  PORT PLB_Clk = sys_clk
  PORT SYS_Rst = sys_reset
END

BEGIN xps_bram_if_cntlr
  PARAMETER INSTANCE = myplbbram_cntlr
  PARAMETER HW_VER = 1.00.b
  PARAMETER C_BASEADDR = 0xFFFF8000
  PARAMETER C_HIGHADDR = 0xFFFFFFFF
  PARAMETER C_SPLB_SMALLEST_MASTER = 128
  PARAMETER C_SPLB_NATIVE_DWIDTH = 32
  BUS_INTERFACE PORTA = porta
  BUS_INTERFACE SPLB = myplb
END

BEGIN bram_block
  PARAMETER INSTANCE = bram1
  PARAMETER HW_VER = 1.00.a
  BUS_INTERFACE PORTA = porta
END

```

```
BEGIN plbv46_master_bfm
  PARAMETER INSTANCE = my_master
  PARAMETER HW_VER = 1.00.a
  PARAMETER PLB_MASTER_ADDR_LO_0 = 0xFFFF0000
  PARAMETER PLB_MASTER_ADDR_HI_0 = 0xFFFFFFFF
  BUS_INTERFACE MPLB = myplb
  PORT SYNCH_OUT = synch0
  PORT SYNCH_IN = synch
END

BEGIN plbv46_slave_bfm
  PARAMETER INSTANCE = my_slave
  PARAMETER HW_VER = 1.00.a
  PARAMETER PLB_SLAVE_ADDR_LO_0 = 0xFFFF0000
  PARAMETER PLB_SLAVE_ADDR_HI_0 = 0xFFFF7FFF
  BUS_INTERFACE SPLB = myplb
  PORT SYNCH_OUT = synch1
  PORT SYNCH_IN = synch
END

BEGIN plbv46_monitor_bfm
  PARAMETER INSTANCE = my_monitor
  PARAMETER HW_VER = 1.00.a
  BUS_INTERFACE MON_PLB = myplb
  PORT SYNCH_OUT = synch2
  PORT SYNCH_IN = synch
END

BEGIN bfm_synch
  PARAMETER INSTANCE = my_synch
  PARAMETER HW_VER = 1.00.a
  PARAMETER C_NUM_SYNCH = 3
  PORT FROM_SYNCH_OUT = synch0 & synch1 & synch2
  PORT TO_SYNCH_IN = synch
END
```

BFM Synchronization Bus Usage

The BFM synchronization bus collects the `SYNCH_OUT` outputs of each BFM component in the design. The bus output is then connected to the `SYNCH_IN` of each BFM component. The following figure depicts an example for three BFMs, and the MHS examples above show their instantiation for OPB, PLB, and PLB v4.6 BFMs.

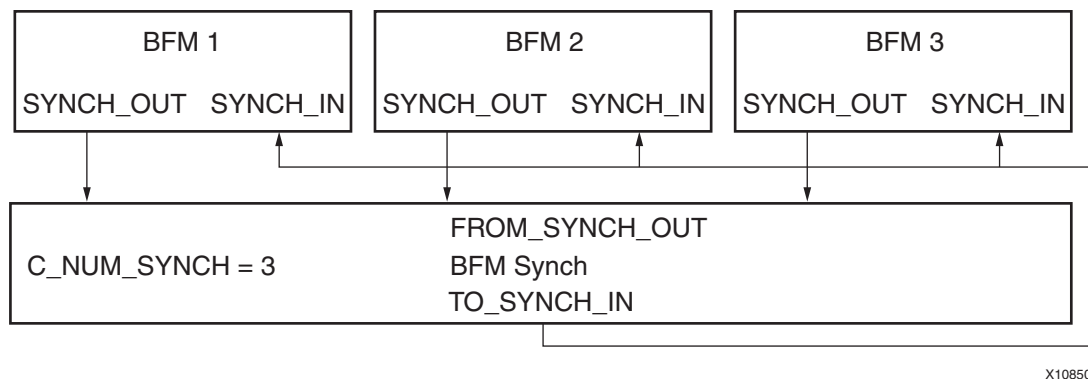


Figure 4: BFM Synchronization Bus Usage

OPB Bus Functional Language Usage

The following is a sample BFL file written for the “OPB BFM Component Instantiation,” page 7, which instantiates OPB BFM components.

```
-- FILE: sample.bfl
-- This example initializes an OPB master
--
-- Initialize my_device
-- Note: The instance name for my_device is duplicated in the
-- path due to the wrapper level inserted by the tools set_device
-- (path=/system/my_device/my_device/device,device_type=opb_device)

-- Write and read 32-bit data using byte-enable architecture
-- Note: The CoreConnect opb_device is a 64-bit device, hence the 8-bit
byte enables
--     are aligned accordingly (shifted by 0's).
write (addr=ffff0100,be=11110000,data=00112233)
write (addr=ffff0104,be=00001111,data=44556677)
read  (addr=ffff0100,be=11110000,data=00000033)
read  (addr=ffff0104,be=00001111,data=00000000)

-- Write and read 16-bit data using byte-enable architecture
write (addr=ffff0100,be=11000000,data=00040004)
read  (addr=ffff0100,be=11000000,data=00040004)
write (addr=ffff0102,be=00110000,data=00400040)
read  (addr=ffff0102,be=00110000,data=00400040)
write (addr=ffff0104,be=00001100,data=04000400)
read  (addr=ffff0104,be=00001100,data=04000400)
write (addr=ffff0106,be=00000011,data=40004000)
read  (addr=ffff0106,be=00000011,data=40004000)
```

```

-- Write and read 8-bit data using byte-enable architecture
write (addr=ffff0100,be=10000000,data=01010101)
read  (addr=ffff0100,be=10000000,data=01010101)
write (addr=ffff0101,be=01000000,data=02020202)
read  (addr=ffff0101,be=01000000,data=02020202)
write (addr=ffff0102,be=00100000,data=03030303)
read  (addr=ffff0102,be=00100000,data=03030303)
write (addr=ffff0103,be=00010000,data=04040404)
read  (addr=ffff0103,be=00010000,data=04040404)
write (addr=ffff0104,be=00001000,data=05050505)
read  (addr=ffff0104,be=00001000,data=05050505)
write (addr=ffff0105,be=00000100,data=06060606)
read  (addr=ffff0105,be=00000100,data=06060606)
write (addr=ffff0106,be=00000010,data=07070707)
read  (addr=ffff0106,be=00000010,data=07070707)
write (addr=ffff0107,be=00000001,data=08080808)
read  (addr=ffff0107,be=00000001,data=08080808)

```

Note: The CoreConnect BFM devices differ in certain bus widths. In this example, the `opb_device` is a 64-bit device, so the byte enable signals are shifted accordingly to match the address alignment. Also, the data mirroring required by the CoreConnect bus specifications are performed on the data field. The adaptation layer translates this into a 32-bit bus width.

More information about the OPB Bus Functional Language is available in the `OpbToolkit.pdf` document in the `$XILINX_EDK/third_party/doc` directory.

PLB Bus Functional Language Usage

The following is a sample BFL file written for the “[PLB BFM Component Instantiation,](#)” [page 9](#) and “[PLB v4.6 BFM Component Instantiation,](#)” [page 10](#), which instantiate the PLB BFM or PLB v4.6 BFM components.

```

-- FILE: sample.bfl
-- This test case initializes a PLB master

-- Initialize my_master
-- Note: The instance name for plb_master is duplicated in the
-- path due to the wrapper level inserted by the tools

set_device(path=/system/my_master/my_master/master,device_type=plb_mas
ter)

-- Configure as 64-bit master
configure(msize=01)

-- Write and read 64-bit data using byte-enable architecture
mem_update(addr=ffff8000,data=00112233_44556677)
mem_update(addr=ffff8008,data=8899aabb_ccddeeff)
write      (addr=ffff8000,size=0000,be=11111111)
write      (addr=ffff8008,size=0000,be=11111111)
read       (addr=ffff8000,size=0000,be=11111111)
read       (addr=ffff8008,size=0000,be=11111111)

```

```

-- Write and read 32-bit data using byte-enable architecture
mem_update(addr=ffff8010,data=11111111_22222222)
write      (addr=ffff8010,size=0000,be=11110000)
write      (addr=ffff8014,size=0000,be=00001111)
read       (addr=ffff8010,size=0000,be=11110000)
read       (addr=ffff8014,size=0000,be=00001111)

-- Write and read 16-bit data using byte-enable architecture
mem_update(addr=ffff8020,data=33334444_55556666)
write      (addr=ffff8020,be=1100_0000)
write      (addr=ffff8022,be=0011_0000)
write      (addr=ffff8024,be=0000_1100)
write      (addr=ffff8026,be=0000_0011)
read       (addr=ffff8020,be=1100_0000)
read       (addr=ffff8022,be=0011_0000)
read       (addr=ffff8024,be=0000_1100)
read       (addr=ffff8026,be=0000_0011)

-- Write and read 8-bit data using byte-enable architecture
mem_update(addr=ffff8030,data=778899aa_bbccddee)
write      (addr=ffff8030,be=1000_0000)
write      (addr=ffff8031,be=0100_0000)
write      (addr=ffff8032,be=0010_0000)
write      (addr=ffff8033,be=0001_0000)
write      (addr=ffff8034,be=0000_1000)
write      (addr=ffff8035,be=0000_0100)
write      (addr=ffff8036,be=0000_0010)
write      (addr=ffff8037,be=0000_0001)
read       (addr=ffff8030,be=1000_0000)
read       (addr=ffff8031,be=0100_0000)
read       (addr=ffff8032,be=0010_0000)
read       (addr=ffff8033,be=0001_0000)
read       (addr=ffff8034,be=0000_1000)
read       (addr=ffff8035,be=0000_0100)
read       (addr=ffff8036,be=0000_0010)
read       (addr=ffff8037,be=0000_0001)

-- Write and read a 16-word line
mem_update(addr=ffff8080,data=01010101_01010101)
mem_update(addr=ffff8088,data=02020202_02020202)
mem_update(addr=ffff8090,data=03030303_03030303)
mem_update(addr=ffff8098,data=04040404_04040404)
mem_update(addr=ffff80a0,data=05050505_05050505)
mem_update(addr=ffff80a8,data=06060606_06060606)
mem_update(addr=ffff80b0,data=07070707_07070707)
mem_update(addr=ffff80b8,data=08080808_08080808)
write      (addr=ffff8080,size=0011,be=1111_1111)
read       (addr=ffff8080,size=0011,be=1111_1111)

```

More information about the PLB Bus Functional Language may be found in the `PlbToolkit.pdf` document in the `$XILINX_EDK/third_party/doc` directory.

Bus Functional Compiler Usage

The Bus Functional Compiler provided with the CoreConnect toolkit is a Perl script called BFC. The script uses a `bfcrc` configuration file, which specifies to the script which simulator is used and the paths to the BFM. Xilinx EDK includes a helper executable called `xilbfc`, which enables this configuration for you. The helper application has been previously used to verify the correct installation on the BFM Package.

To compile a BFL file, type the following at a command prompt:

```
xilbfc sample.bfl
```

This creates a script targeted for the selected simulator that initializes the BFM devices. In the case of ModelSim, it creates a file called `sample.do`.

Running BFM Simulations

To run the BFM simulation, you must:

1. Compile the simulation HDL files.
2. Load the system into the simulator.
3. Initialize the Bus Functional Models.
4. (Optionally) create a waveform list or load a previously created one.
5. Provide the clock and reset stimulus to the system.
6. Run the simulation.

The following is an example script called `run.do`, which you can write to perform the steps listed above:

```
do system.do
vsim system
do sample.do
do wave.do
force -freeze sim:/system/sys_clk 1 0, 0 {10 ns} -r 20 ns
force -freeze sim:/system/sys_reset 0, 1 {200 ns}
run 2 us
```

Note: If your design has an input reset that is active high, replace the reset line with:
`force -freeze sim:/system/sys_reset 1 , 0 {200 ns}`

At the ModelSim prompt type:

```
do run.do
```