XRC Board Level Application Library v2.1c
(For Simulink and System Generator)

ALPHA DATA

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1 Introduction

The Alpha Data XRC Board Level Application Library 2.1 is a collection of embedded IP, VHDL, Simulation Models, and a top level Wrapper Builder application, all designed to ease the design of FPGA applications on Alpha Data Embedded PMC and PCI cards. These modules are designed to work with Xilinx System Generator and Simulink from the Mathworks.

1.1 Whats New

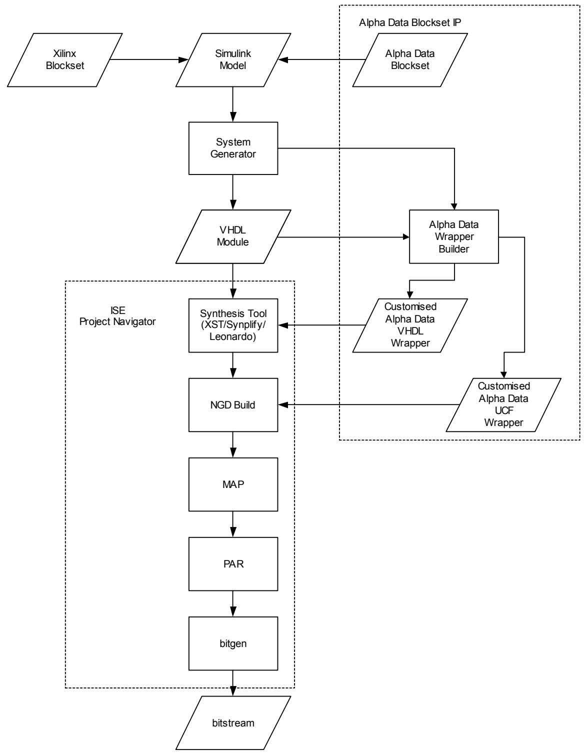
Updates from 2.1b to 2.1c

Support for Xilinx ISE 7.1 has been added. Due to changes in the ISE project file format (.npl files are no longer used, .ise files replace these), when using System Generator and ISE 7.1, the automatic wrapper generation can no longer modify the ISE project files. Therefore some manual modification of the project within ISE is now required.

Updates from 1.7 to 2.1

Compared to Applications Blockset 1.7 there are many changes. The move to the module based embedded blocks, introduced in 2.0, for handling the local bus and memory has been retained. The design methodology is now no longer template based. However unlike 2.0, there is now automatic wrapper generation, and semi-automatic bitstream generation. An menu option has been added to the Xilinx System Generator block to allow the automatic wrapping of top level ports, generation of wrapper VHDL and UCF files and automatic running start up of Xilinx Project Navigator for synthesis and implementation.

The design flow is now as follows:



There have also been several enhancements to the IP blocks. The most significant of which is the introduction of an On-Chip Bus ADLOCB (Alpha Data Local - to On Chip Bus) which allows direct access from the host over PCI to the off-chip memory. With this system, the RAM interface modules, which need to be accessed from the Local Bus, are connected up in a ring in System Generator. This allows the user to choose which modules to connect up. It may be desirable, not to connect up some modules to save on logic or help meet a critical timing requirement.

2 Installation Instructions

The XRC Board Level Application Library is provided as a zip file and a Matlab installation script:

xrc_application_blockset.zip
setup_xrc_application.m

1) Open Matlab

2) Change Directory to where xrc_application_blockset.zip and setup_xrc_application.m have been downloaded.

3) Type setup_xrc_application

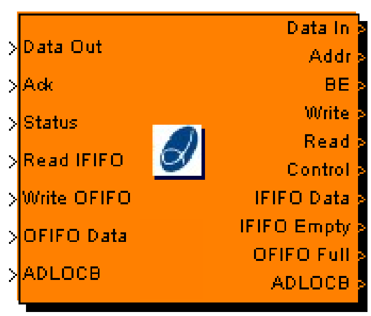
4) Quit Matlab

3 XRC Simulink Blockset

The XRC Blockset provides simulation and synthesis models to handle the most common I/O tasks in the ADM-XRC Series of cards. Communication with the host is through a Local Bus bridge and PCI. The modules provided have control and status registers (for simple control; tasks), a slow, asynchronous, memory mapped, slave interface (for more sophisticated control and small data transfers), and input and output demand mode DMA FIFO's for large high speed data transfers to and from the host. The other modules provided interface to the off-chip memory on each card (ZBT, DDR-SDRAM, DDR-II SSRAM). Other I/O is generally unidirectional and synchronous to the System Generator clock domain, and this can be implemented using the standard System Generator I/O ports. All the modules contain ADLOCB ports. This allows the components to be chained together on a single bus controlled by the host, and allow fast background access to the off-chip memory.

3.1 Local Bus Interface Modules

3.1.1 LBIF_PLX32



PLX 32 Bit Interface

This interface connects to the PLX9656 PCI bridge chip used on the ADM-XRC-II. It provides the following ports:

Control : (UFix_32_0) -- control register value – set by host at address 0x40000
Status : (Ufix_32_0) -- status register – read by host at address 0x40040

The slave memory mapped interface uses the following ports:
Data_Write: (Ufix_32_0) -- data written by host
Addr: (UFix_16_0) -- 32 bit address for read or write
BE: (Ufix_4_0) -- byte enables
Write: (Boolean) -- host wants to write data (Data_Write) to Address (Addr)
Read: (Boolean) -- host wants to read data from Address(Addr)
Data_Read: (UFix_32_0) -- data to be returned to host
Ack: (Boolean) -- indicates that Data_Read is valid – must be asserted in response to Read.

The slave memory is mapped to local bus addresses 0x000000-0x03FFFC

The Demand Mode DMA FIFOs are connected to the PLX9656 DMA channels, with writes from the host on DMA channel 0 resulting in Data Being pushed into IFIFO, and reads from the host on DMA channel 1, pops data out of OFIFO. Since Demand Mode DMA is used the host process will block if IFIFO is full or OFIFO is empty.

IFIFO Ports are:
IFIFO_Data: (UFix_32_0)
IFIFO_Empty: (Boolean)
Read_IFIFO: (Boolean)

OFIFO Ports are:
OFIFO_Data: (UFix_32_0)
OFIFO_Full: (Boolean)
Write_OFIFO: (Boolean)

The following C-Code for accessing these can be used. The Demand Mode DMA application in the ADM-XRC SDK should also be consulted to see how to set up Demand Mode DMA transfers. With this module the DMA counters at Local Bus locations 0x040080 and 0x0400C0, and these should be set before starting the DMA transfer.

```
void sendData(int offset, int size)
{
  ADMXRC2_STATUS              status;
  HANDLE                              event;

  event = CreateEvent(NULL, TRUE, FALSE, NULL);
  /*
  ** Program the PCI-to-local transfer counter.
  */
  fpgaSpace[65568] = size;
  fpgaSpace[65568];

  /*
  ** Perform the DMA transfer.
  */
  status = ADMXRC2_DoDMA(card,sendbufHandle,offset,size,0x40,
                      ADMXRC2_PCITOLOCAL,0,mode,0,NULL,event);
  CloseHandle(event);
}

void recvData(int offset, int size)
{
  ADMXRC2_STATUS              status;
  HANDLE                              event;

  event = CreateEvent(NULL, TRUE, FALSE, NULL);

  /*
  ** Program the local-to-PCI transfer counter.
  */
  fpgaSpace[65584] = size;
  fpgaSpace[65584];
```

```
  /*
  ** Perform the DMA transfer.
  */
  status = ADMXRC2_DoDMA(card,recvbufHandle,offset,size,0x80,
                         ADMXRC2_LOCALTOPCI,1,mode,0,NULL,event);
   CloseHandle(event);
}
```

Two parameters are provided for the Local Bus Interface Block, the first “Local Bus script Program” is used to simulate Local Bus transactions. The second parameter “Clock Ratio” sets the ratio used in simulation between Local Bus Clock Cycles and the System Generator System Clock e.g. if this is set to 1.5 then the Local Bus program will update its outputs every 1.5 System Clock cycles.

The Local Bus Script Program can be specified as a string or as a Matlab variable. If either of these is specified as load <filename.txt> then the file <filename.txt> will be loaded and parsed in place of the string.

The following commands are parsed:

slave_read <address>
: reads the contents of a local bus address and displays the result

slave_write <address> <data> [be]
: write 32 bit integer <data> to address with optional byte enable signal

dma_read <length> [matlab variable]
: reads <length> words from OFIFO and either displays them or stores them in a a [matlab variable]

dma_write <length> [matlab variable]
: writes <length> words into IFIFO. If a [matlab variable] is specifed then this is used as data otherwise integers 1..<length> are sent

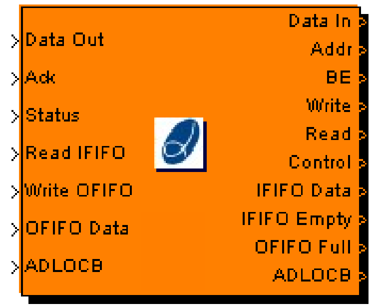
sleep <count>
: this pauses the simulation program for <count> LCLK cycles

Example Program:

```
slave_write 0x40000 0xabcd1234
slave_read 0x40000
slave_read 0x40040
slave_write 0x0 0x1234abcd
dma_write 8 myfifo_in
dma_read 8 myfifo
slave_read 0x0
```

N.B. There is a 32K limit on the size of the program.

3.1.2 LBIF_XPL32

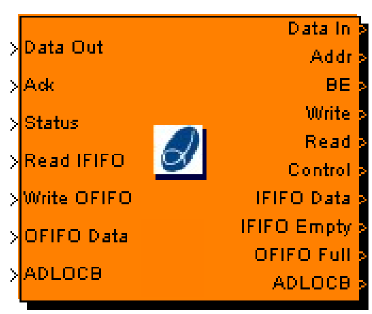


XPL 32 Bit Interface

This interface connects to the XPL PCI-Local Bus Bridge used on the ADM-XPL and ADM-XP. Functionally this module performs identically to the LBIF_PLX32 module. In implementation there are minor differences in the VHDL top level ports produced, as the data and address pins are multiplexed with the XPL bridge, unlike the PLX9656.

N.B. Due to the default clock frequency ratio between the sysgen clock domain and the Local Bus clock domain, special consideration has to be taken when generating Data Out. The asynchronous transfer register used to sample Data Out, will sample Data Out between ½ and 1 Local Bus clock cycles after Ack is asserted. Since the Sysgen clock frequency is by default twice the Local Bus clock frequency, Data Out should be held for 1 clock cycle after Ack is asserted to ensure correct transfer.

3.1.3 LBIF_XPL64



XPL 64 Bit Interface

This module is similar to LBIF_PLX32 and LBIF_XPL32, however the data widths are 64 bits wide. The ports therefore are

Control : (UFix_64_0)
Status : (Ufix_64_0)
Data_Write: (Ufix_64_0)

Addr: (UFix_16_0)
BE: (Ufix_8_0)
Write: (Boolean)
Read: (Boolean)
Data_Read: (UFix_64_0)
Ack: (Boolean)
IFIFO_Data: (UFix_64_0)
IFIFO_Empty: (Boolean)
Read_IFIFO: (Boolean)
OFIFO_Data: (UFix_64_0)
OFIFO_Full: (Boolean)
Write_OFIFO: (Boolean)

The host application should set the Local Bus Space up to allow 64 bit access. The DMA Mode bit for 64 bit access should also be set.

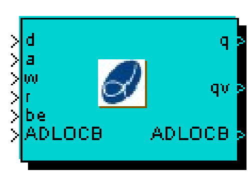
A similar format is used for the Local Bus Script Program but with one minor changes to deal with 64 bit values:
slave_write <address> <data0> [data1] [be]
will write data0 to the lower 32 bits and data1 to the upper 32 bits if specified

N.B. the address input does not change and is still refers to a 32 bit word address. So bit 0 may be ignored if 64 bits transfers are being used.

3.2 Memory Modules

Each card has a number of memory interface modules to allow access to the off-chip memory. With the SRAM modules, the memory is accessed directly. With the DRAM modules, assess is via a cache. For simulation, it is possible to initialise the memory from Matlab by specifying the contents of the variables: *sram0, sram1, sram2* etc. for the SRAM banks, and *dram0, dram1* for the DRAM banks. Each element is converted into a 32 bit integer. For 64 bit memories, 2 elements are written to each location with the lower 32 bits written first. When the simulation finishes, the memory contents are written back into the Matlab variables, however the size of the variable is used to determine how much data is transferred back to Matlab.

3.2.1 ZBT SRAM (32 bit)

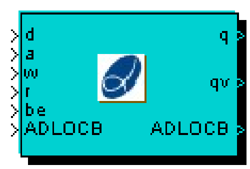


ZBT SRAM 0

These modules implement the 32bit ZBT SRAM on the ADM-XRC-II.
Ports are:
d : UFix_32_0
a : UFix_20_0
w : Boolean
r : Boolean
be : UFix_4_0
q : UFix_32_0
qv : Boolean

If “w” is asserted then data of “d” is stored in the SRAM at address “a”.
If “r” is asserted then SRAM address “a” is read and the output appear on “q” 4 clock cycles later, with “qv” going high to indicate that it is valid.

3.2.2 ZBT SRAM (64 bit)

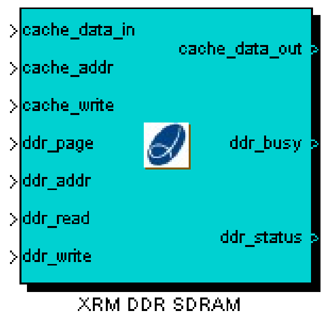


ZBT SRAM 64

This module implement the 64bit ZBT SRAM on the ADM-XPL.
Ports are:
d : UFix_64_0
a : UFix_20_0
w : Boolean
r : Boolean
be : UFix_8_0
q : UFix_64_0
qv : Boolean

If “w” is asserted then data of “d” is stored in the SRAM at address “a”.
If “r” is asserted then SRAM address “a” is read and the output appear on “q” 4 clock cycles later, with “qv” going high to indicate that it is valid.

3.2.3 XRM-DDR SDRAM (64 bit)



This module implements and interface to the XRM-DDR SDRAM on the XRM-DDR module. The data interface to the System Generator module is via an 8K cache memory block RAM, with a 1 clock cycle latency.

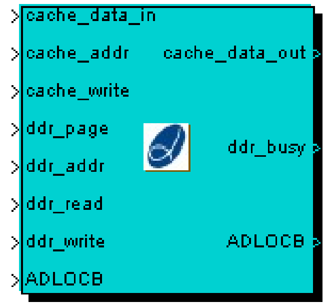
Ports are:
cache_data_in : UFix_32_0
cache_data_out : UFix_32_0
cache_addr: UFix_11_0
cache_write: Boolean

Control signals are used to burst the data from the 8K cache to the DDR
ddr_page : UFix_14_0 is used to select an 8K page in the DDR
ddr_addr : UFix_4_0 Selects a 512 byte block within the cache
ddr_read : Boolean – when asserted the 512 byte block is copied from DDR to Cache
ddr_write : Boolean – when asserted the 512 byte block is copied from Cache to DDR
ddr_busy : Boolean -- Indicates whether a burst is in operation or not. While ddr_busy is high, ddr_read and ddr_write will be ignored.

The time for a burst will vary as it may have to wait for a refresh to finish, however each burst should take between 36 (usual) and 43 (worst case) clock cycles.

N.B. The XRM DDR SDRAM module does not currently support ADLOCB connection.

3.2.4 DDR SDRAM (32 bit)



DDR SDRAM

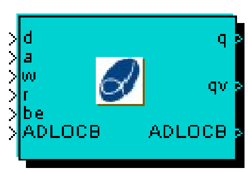
These modules implement the interface to the DDR SDRAM on the ADM-XPL and ADM-XP. The data interface to the System Generator module is via a 4K cache memory block RAM, with a 1 clock cycle latency.

Ports are:
cache_data_in : UFix_32_0
cache_data_out : UFix_32_0
cache_addr: UFix_10_0
cache_write: Boolean

Control signals are used to burst the data from the 4K cache to the DDR
ddr_page : UFix_15_0 is used to select an 4K page in the DDR
ddr_addr : UFix_4_0 Selects a 256 byte block within the cache
ddr_read : Boolean – when asserted the 256 byte block is copied from DDR to Cache
ddr_write : Boolean – when asserted the 256 byte block is copied from Cache to DDR
ddr_busy : Boolean -- Indicates whether a burst is in operation or not. While ddr_busy is high, ddr_read and ddr_write will be ignored.

The time for a burst will vary as it may have to wait for a refresh to finish, however each burst should take between 36 (usual) and 43 (worst case) clock cycles.

3.2.5 DDR-II SSRAM



DDRII SRAM 0

These modules implement the interface to the DDR-II SSRAM on the ADM-XP. The 32 bit DDR ports on the devices are mapped to single clock 64 bit wide ports. The SSRAM devices have a burst length of 4, and therefore the minimum transfer to the

RAM will take 2 clock cycles. This creates some operational limitations of the use of these devices.

Ports are:
d : UFix_64_0
a : UFix_21_0
w : Boolean
r : Boolean
be : UFix_8_0
q : UFix_64_0
qv : Boolean

For writes, the DDR-II controller waits for a second write “w” before bursting both data elements to the SRAM, in successive locations. The addresses used will be “a” when the first write is asserted and “a”+1. The byte enables can be specified separately for each write. Write bursts can be continuous, but should contain an even number of writes. “a” should be incremented every write.

Read “r” should not be asserted after an odd number of writes. It should also not be asserted one clock cycle after the last write.

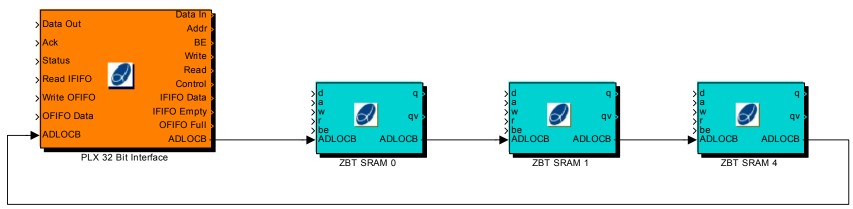
Reads to an even address “a(0)”= 0 will generate two reads 3 and 4 clock cycles after “r” is asserted. “qv” will indicate that the data in “q” is valid. For reads to an odd address “a(0)” =1, one read will be generated and the data will be valid after 4 clock cycles.

Read bursts can be continuous, for as long as “r” is asserted, and “a” is incremented every clock cycle.

For correct operation the DDR-II-SSRAM must be clocked at over 75MHz and less than 133MHz.

3.3 ADLOCB

The Alpha Data Local to On Chip Bus interface provides a fast, simple to use mechanism for high speed data transfers between the host and off-chip memory with minimal impact on the System Generator design logic.



The ADLOCB requires a Local Bus Interface module to act as the master. RAM modules are then connected in a ring as slaves. Finally the last RAM output should be connected back to the Local Bus Interface to provide a data path for reading data.

From the host, the ADLOCB is mapped into the FPGA into a 2MB window at addresses 0x200000 to 0x3FFFFF. A page/device register is provided at address 0x040100. The lower 16 bits are used to identify the off chip memory device. The SRAM devices are indexed first with the DRAM device numbers depending on the number of SRAM devices on the board. On the XRC-II, ZBT SRAM banks 0 to 5 have device numbers 0 to 5. On the XPL, the ZBT SRAM is device 0 and the DDR SDRAM is device 1. On the XP, the DDR SRAM banks have device numbers 0 to 3 and the DDR DRAM banks have device numbers 4 and 5.

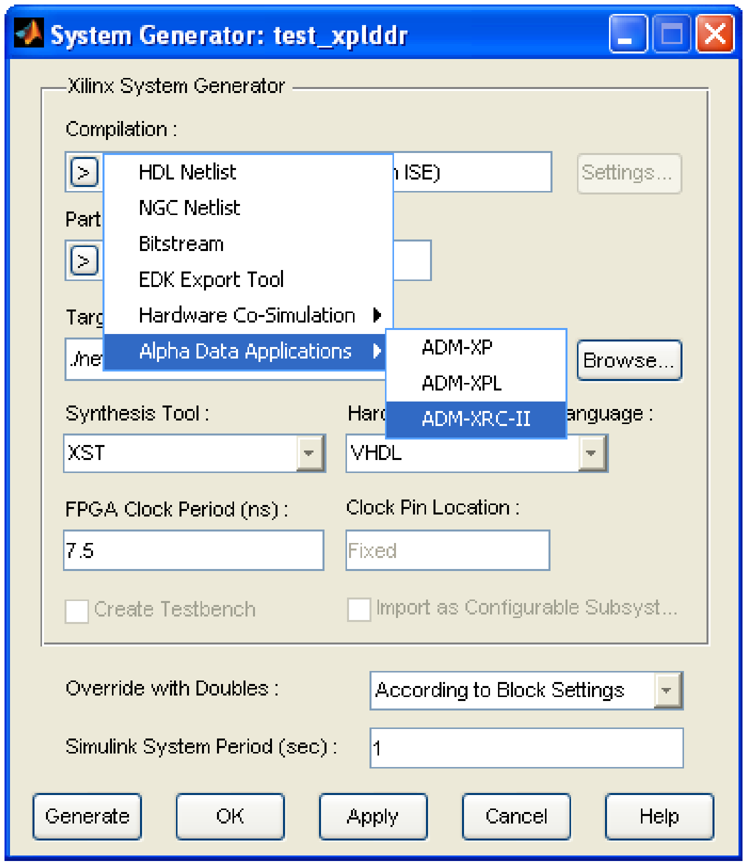
The upper 16 bits (0x040102) of the register are used to select the upper address bits of the memory if the RAM bank is larger than 2MB.

The ADLOCB system does not include any mutual exclusion logic. Host accesses will have higher priority than System Generator Logic accesses, however simultaneous access to any memory may produce unexpected results. The application should implement the appropriate mutual exclusion logic, using the status and control registers to indicate when it is safe for the host and System Generator to access memories.

The Cache in the SDRAM also introduces a twist in the data on a 16 bit boundary. 32 bit elements D0 and D1 at addresses A0, A0+1, appear on the Local bus in the order:
LA(0) : LD(31:0) = [D1(15:0) D0(15:0)]
LA(1) : LD(31:0) = [D1(31:16) D0(31:16)]

4 Wrapper File Generation

The VHDL produced by System Generator cannot handle all the interfacing requirements for the ADM-XRC series cards. Therefore the VHDL module produced must be wrapped before synthesizing and generating a bitstream.



A new compilation option has therefore been added to the System Generator Token. When Generate is run with this option selected this will run through the System Generation process to produce VHDL. The wrapper builder will the run and create a vhdl file, a ucf file and an ISE Project Navigator file. (<design>_top.vhd, <design>_top.ucf, <design>_top.npl).

This wrapper builder will identify all the external ports associated with the embedded IP modules. It will then connect up the appropriate clocking circuits and tri-state buffers. It will also identify any user defined ports (in Gateway blocks), and if Pin constraints are specified in the Gateway block, these will be propagated to the UCF file. Project Navigator will then be launched, so that the bitstream can be generated.

If the wrapper builder detects that the wrapper files have already been generated it will provide the option to not rebuild them. It is only necessary to rebuild them if the ports in the System Generator design have changed. (i.e. after the addition or deletion of any PCI, RAM or Gateway blocks.) Selecting Yes will rebuild the wrapper files, and will also back up the old files; selecting No, will leave the wrapper files unchanged, but still launches Project Navigator; selecting Cancel will skip the launching of Project Navigator. The wrapper building stage can be avoided completely by changing the Compilation Option back to HDL netlist, which will limit the changes to the System Generator VHDL.

In many cases the default generated wrapper VHDL and UCF might not quite match the users requirements. However these can be modified, (e.g. to change the system clock pin, or add in timing or area group constraints) with any text editor or within the Project Navigator environment. In these cases after each generation the user should select not to rebuild the wrapper files, or change the Compilation Option back to HDL netlist.

N.B. for Synplify/Synplify Pro Users, the UCF file generated uses <> as bus delimiter symbols, however by default Synplify and Synplify Pro use () . Therefore before running Synthesize, a Synplify Constraints file (.sdc) containing the following specification:

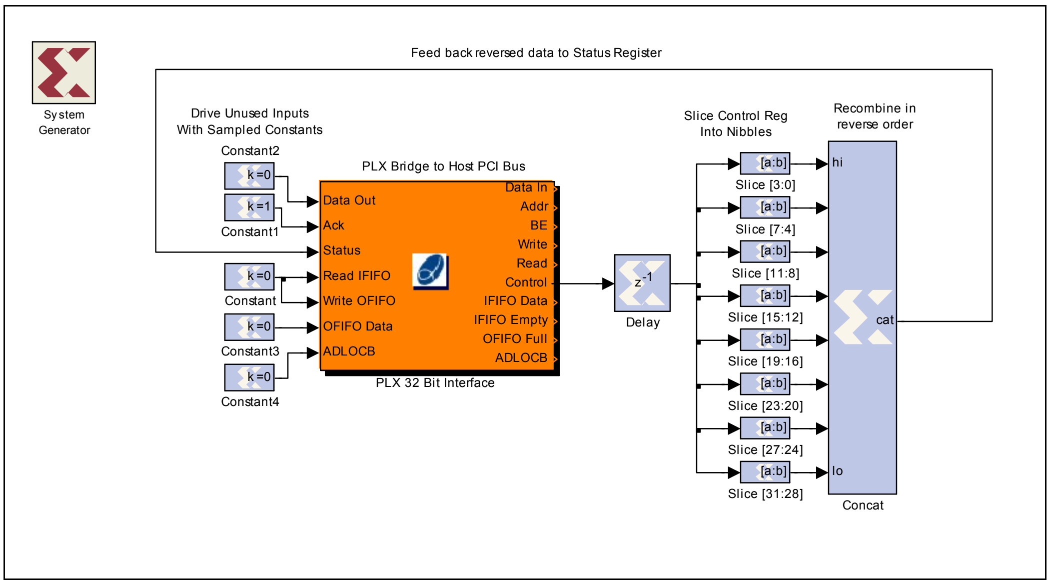
```
define_global_attribute syn_edif_bit_format {%n<%i>}
```

must be added to the project. Select the "Properties…" option from the Synthesize Process menu, and select the Constraint File Options Tab which allows the specification of a file. A suitable file can be found in %ADMXRC_SDK4%\fpga\vhdl\common\synpro_bus.sdc if the ADM SDK is installed.

5 Example Applications

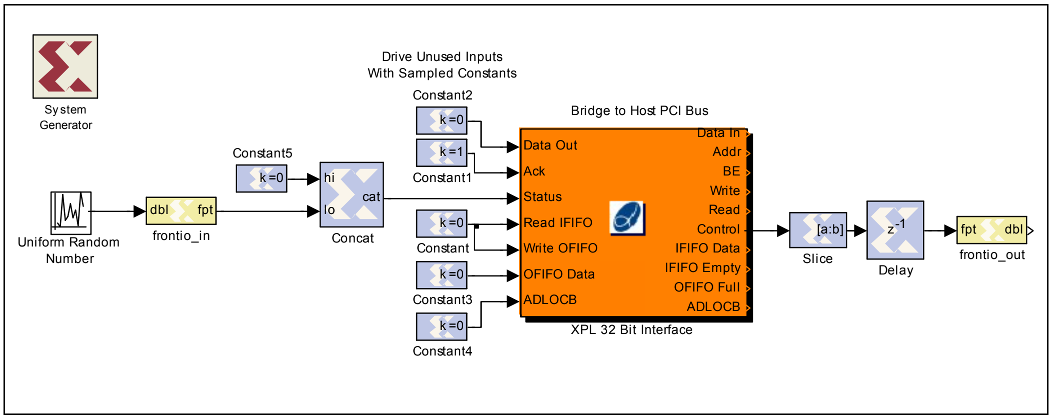
Three simple applications are provided for each board. These applications demonstrate basic connections to the Local Bus Interface, basic I/O and a simple memory application. Separate applications for each board are provided in examples/admxrc2, examples/admxpl, examples/admxp. Matlab scripts simple.m and memory.m are provided in the examples directory to run these applications from within Matlab.

5.1 Simple



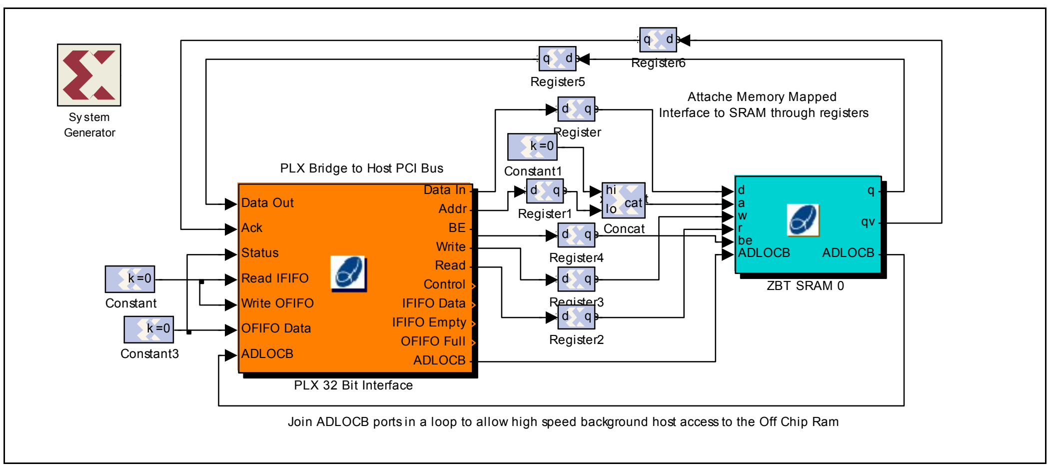
This example here shows the simplest possible interface using the PLX/XPL Interface Module. Data from the control register is nibble reversed and then output to the status register.

5.2 Front I/O



This example connects up pins on a front panel XRM I/O to the control and status registers. The pin definitions for frontio_in and frontio_out can be included in the Gateway Blocks.

5.3 Memory

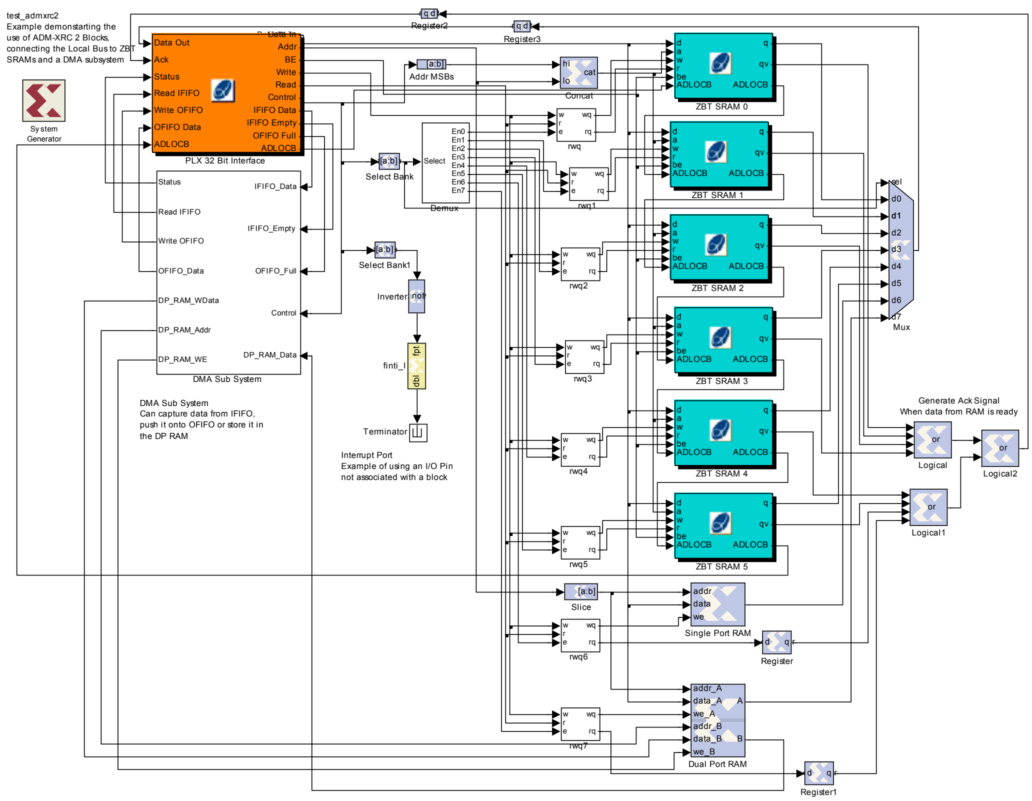


This example demonstrates how to connect up a simple memory mapped interface. It also shows how to connect up the ADLOCB ports in the modules.

6 Advanced Example Applications

Five advanced test applications are provided which demonstrate how to connect up the Local Bus Interface, the DMA FIFOs and the ZBT SRAM, DDR SDRAM and DDR-II SSRAM. These examples are located in the directory test.

6.1 *"test_admxrc2"*



This example is for the ADM-XRC-II and connects up all 6 Banks of ZBT SRAM to the Local Bus Interface. The control register is used to select which of the 6 banks the Local Bus accesses, or if it accesses one of 2 block RAMs. The DMA FIFO's are connected up, and these can loop the data round (IFIFO -> OFIFO), capture the data (IFIFO -> Block RAM 7) or output the Block RAM Data (Block RAM 7 -> OFIFO).

Control Register Bits:

(2:0) Select RAM Bank
000 ZBT SRAM 0
001 ZBT SRAM 1
010 ZBT SRAM 2
011 ZBT SRAM 3
100 ZBT SRAM 4

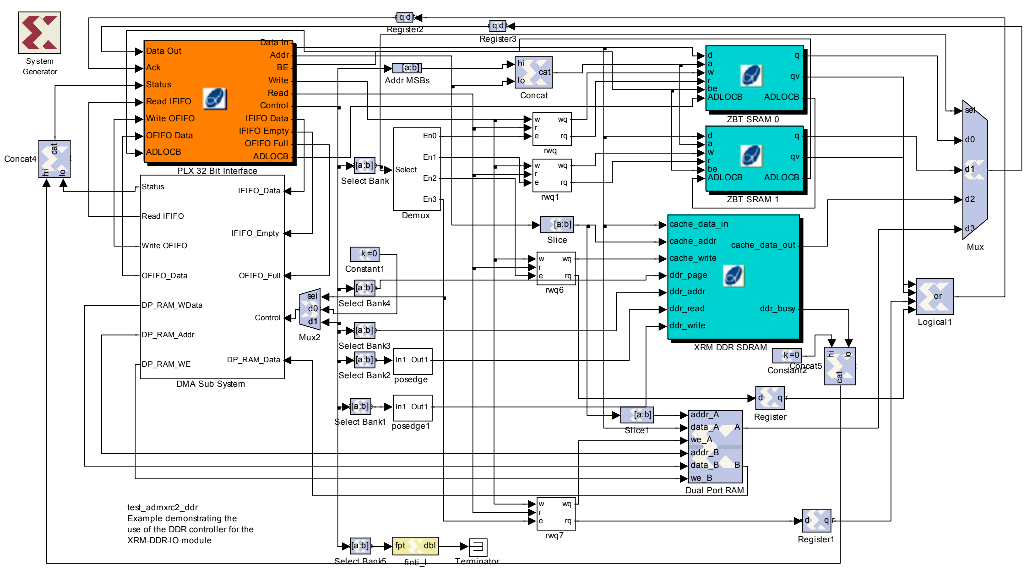
101 ZBT SRAM 5
110 Block RAM 6
111 Block RAM 7 (DMA FIFO Capture)

(7:4) MSBs of ZBT Address
These bits are used as a page register for the ZBT Bank being accessed

(16) DMA FIFO WriteThrough – copies any input on the IFIFO to OFIFO
(17) DMA FIFO Capture – writes any data input on IFIFO to Block RAM 7
(18) DMA FIFO Burst – triggers a burst of data from Block RAM 7 to OFIFO

(24) Interrupt Bit – connected to the FPGA interrupt pin – demonstrates how to connect an output signal which is not part of the module.

6.2 *"test_admxrc2_ddr"*



This example is for the ADM-XRC-II with an XRM-DDR I/O module attached. The main purpose of this module is to demonstrate the operation of the DDR SDRAM controller. This module has a simple cache interface which is connected to the local bus and reads and writes between this and the DDR is controlled using the control register.

Control Register Bits:
(1:0) Select RAM Bank
00 ZBT SRAM Bank 0
01 ZBT SRAM Bank 1
10 DDR SDRAM Cache
11 Block RAM 3 (DMA FIFO Capture)

(2) Trigger DDR Read (DDR Data to Cache)
(3) Trigger DDR Write (Cache Data to DDR)

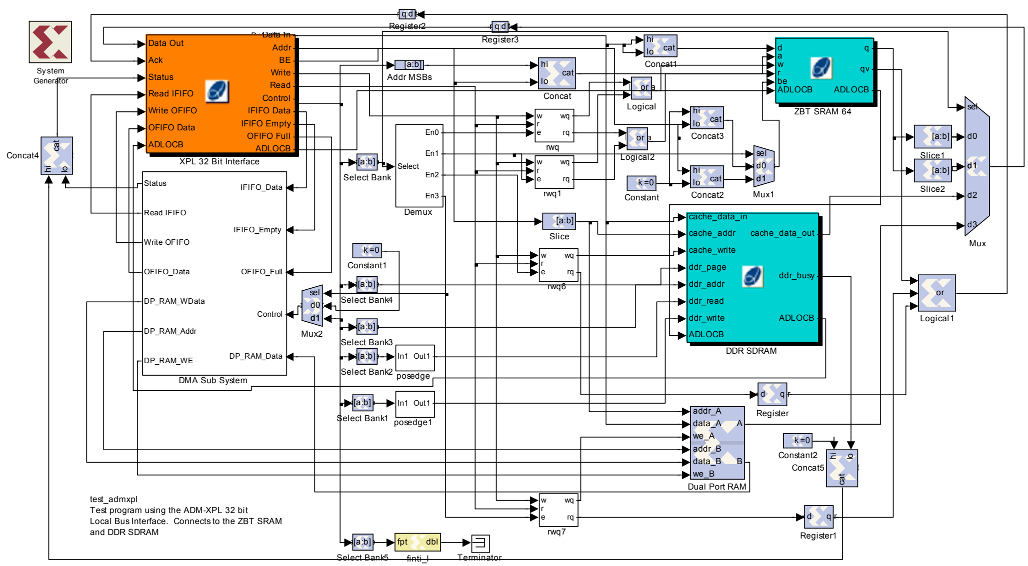
(7:4) MSBs of ZBT Address
These bits are used as a page register for the ZBT Bank being accessed

These bits are also used to control the DMA when bits (1:0) = “11”
(4) DMA FIFO WriteThrough – copies any input on the IFIFO to OFIFO
(5) DMA FIFO Capture – writes any data input on IFIFO to Block RAM 3
(6) DMA FIFO Burst – triggers a burst of data from Block RAM 3 to OFIFO

(11:8) DDR Addr – In Page address of burst
(8K Cache is divided into 16 blocks each of which can be burst to/from the DDR)

(29:16) DDR Page
Page in DDR Memory used for burst

6.3 *“test_admxpl”*



This example is for the ADM-XPL and shows how to connect the ZBT SRAM and the DDR SDRAM to the 32 bit Local Bus module. This also contains the DMA FIFO interface used in the previous example. The 64 bit ZBT SRAM is divided into 2 32 bit banks accessed independently using Byte Enables

Control Register Bits:
(1:0) Select RAM Bank
00 ZBT SRAM Lower 32 bits
01 ZBT SRAM Upper 32 bits
10 DDR SDRAM Cache

11 Block RAM 3 (DMA FIFO Capture)

(2) Trigger DDR Read (DDR Data to Cache)
(3) Trigger DDR Write (Cache Data to DDR)

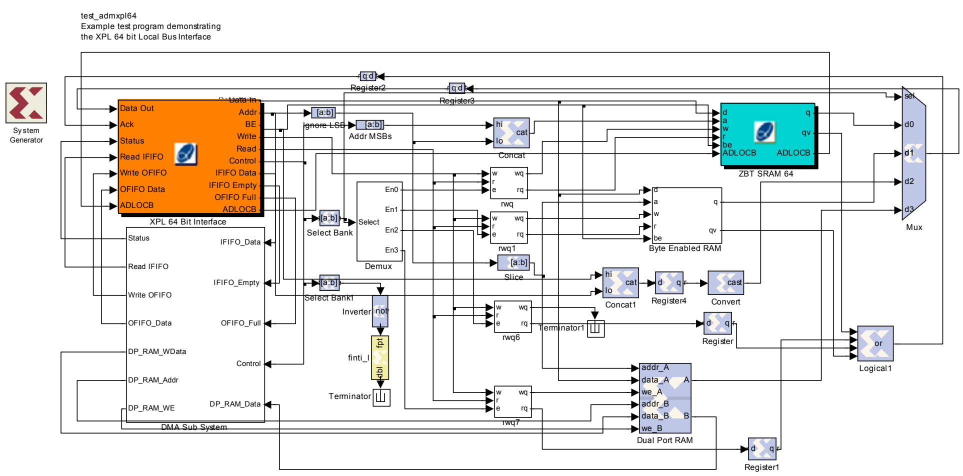
(7:4) MSBs of ZBT Address
These bits are used as a page register for the ZBT Bank being accessed

These bits are also used to control the DMA when bits (1:0) = “11”
(4) DMA FIFO WriteThrough – copies any input on the IFIFO to OFIFO
(5) DMA FIFO Capture – writes any data input on IFIFO to Block RAM 3
(6) DMA FIFO Burst – triggers a burst of data from Block RAM 3 to OFIFO

(11:8) DDR Addr – In Page address of burst
(4K Cache is divided into 16 blocks each of which can be burst to/from the DDR)

(29:16) DDR Page
Page in DDR Memory used for burst

6.4 *“test_admxpl64”*



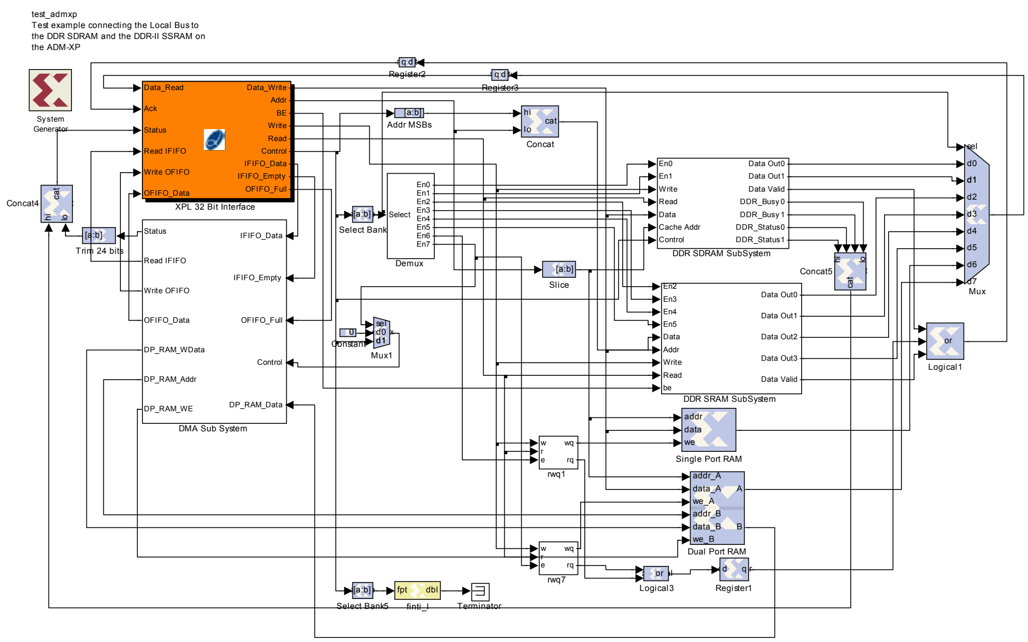
This model is also for the ADM-XPL. This example demonstrates how to use the 64 bit Local Bus. This is connected to the 64 bit ZBT, and to block RAMS, some configured so that the byte enables work.

Control Register Bits:
(1:0) Select RAM Bank
00 ZBT SRAM
01 Byte Enabled Block RAM
10 Address Feedback Register
11 Block RAM 3 (DMA FIFO Capture)

(8:4) MSBs of ZBT Address
These bits are used as a page register for the ZBT Bank being accessed

(16) DMA FIFO WriteThrough – copies any input on the IFIFO to OFIFO
(17) DMA FIFO Capture – writes any data input on IFIFO to Block RAM 3
(18) DMA FIFO Burst – triggers a burst of data from Block RAM 3 to OFIFO

6.5 *"test_admxp"*



This model is for the ADM-XP. It connects the 32 bit Local Bus interface to the DDR SDRAM and DDR-II SRAM modules.

Control Register Bits:

(2:0) Select RAM Bank
000 DDR SDRAM 1
001 DDR SDRAM 2
010 DDR-II SRAM 0
011 DDR-II SRAM 1
100 DDR-II SRAM 2
101 DDR-II SRAM 3
110 Block RAM 6
111 Block RAM 7 (DMA FIFO Capture)

(8:4) MSBs of DDR-II SDRAM Address
These bits are used as a page register for the ZBT Bank being accessed

These bits are also used to control DDR to Cache Transfers when either DDR SDRAM bank is active.
(4) Trigger DDR Read (DDR Data to Cache)
(5) Trigger DDR Write (Cache Data to DDR)

These bits are also used to control the DMA when bits (2:0) = “111”
(4) DMA FIFO WriteThrough – copies any input on the IFIFO to OFIFO
(5) DMA FIFO Capture – writes any data input on IFIFO to Block RAM 3
(6) DMA FIFO Burst – triggers a burst of data from Block RAM 3 to OFIFO

(11:8) DDR Addr – In Page address of burst
(4K Cache is divided into 16 blocks each of which can be burst to/from the DDR)

(29:16) DDR Page
Page in DDR Memory used for burst

6.6 Running the Test Examples

Example C code is also provided to load these bitstreams into an FPGA and test all the interfaces implemented. This code is located in directory test\c-src. The code test_admxrc2.c will test test_admxrc2.bit and test_admxrc2_ddr.bit on an ADM-XRC-II. The code test_admxpl.c will test test_admxpl.bit and test_admxpl64.bit on an ADM-XPL. The code test_admxp.c tests test_admxp.bit on an ADM-XP.