Integrating DSP Builder with SOPC Builder

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Why DSP Builder?

- DSP Builder, through Simulink, makes developing, testing, and implementing DSP designs (relatively easy)

- Prototype/test DSP algorithm in MATLAB before implementing on FPGA
DSP in an SOPC

- FPGAs (especially contemporary ones) are very efficient at performing DSP
  - Lots of parallel compute resources
  - Custom hardware MACs for fabric efficiency
  - Definitely more efficient than running the DSP algorithm in software on a microprocessor
- SOPC design flow makes designing complex systems easier than “raw” VHDL/Verilog
How do we Integrate DSP Builder Designs into SOPC Builder?

• EXTREMELY PAINFUL: Produce DSP design as VHDL and “manually” make it into a custom peripheral

• Less painful: Altera-MM Interface Blocks

• Not so bad: Altera-MM FIFOs
Altera-MM FIFOs

- **FIFO** == **First In, First Out** (a.k.a. a queue)
- Used to provide a simple, straightforward interface between the Avalon fabric and DSP Builder blocks
- Read FIFOs and Write FIFOs
"Streaming Interface"

- FIFOs work best with DSP Builder Blocks that operate in a streaming manner.
- DSP Builder Blocks should be able to continuously take in input data and produce output data.
FIFO Blocks

- **Ready** – signals that we're ready to accept more data
- **Data/DataOut** – the actual data bus
- **DataValid** – values on Data/DataOut are valid and can be read
Overall Design Flow (Algorithm Development)

- Avalon-MM FIFO Modules are Simulink blocks
- You can test the design in Simulink with the Avalon-MM FIFO blocks attached
Overall Design Flow (Lowering to VHDL*)

- Can test whether the behavioral hardware design is equivalent to the original Simulink algorithm
- *Note that Signal Compiler only outputs VHDL (no Verilog)
Overall Design Flow (Quartus/SOPC Builder)

- If you did everything right, there should be a peripheral under the “DSPBuilder Systems” category
- The rest of this is more or less a standard SOPC design flow
Overall Design Flow (NIOS II IDE)

1. Create NIOS II Software
2. Load Software Onto SOPC design
3. See if it works???
Recommended Reading

- **DSP Builder User Guide** – provides a lot of walkthroughs and tutorials for DSP Builder.

- **Chapter 7** discusses how to interface DSP Builder with SOPC Builder. Provides a good tutorial as well.

- Also, look at the example projects enumerated in Chapter 7.