The Abdus Salam
International Centre
for Theoretical Physics

IAEA

Joint ICTP-IAEA School on
Systems-on-Chip based on
FPGA for Scientific Instrumentation
and Reconfigurable Computing

Introduction to Laboratory 4

SoC-FPGA DAQ system and TCL

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Lab 4: Objectives

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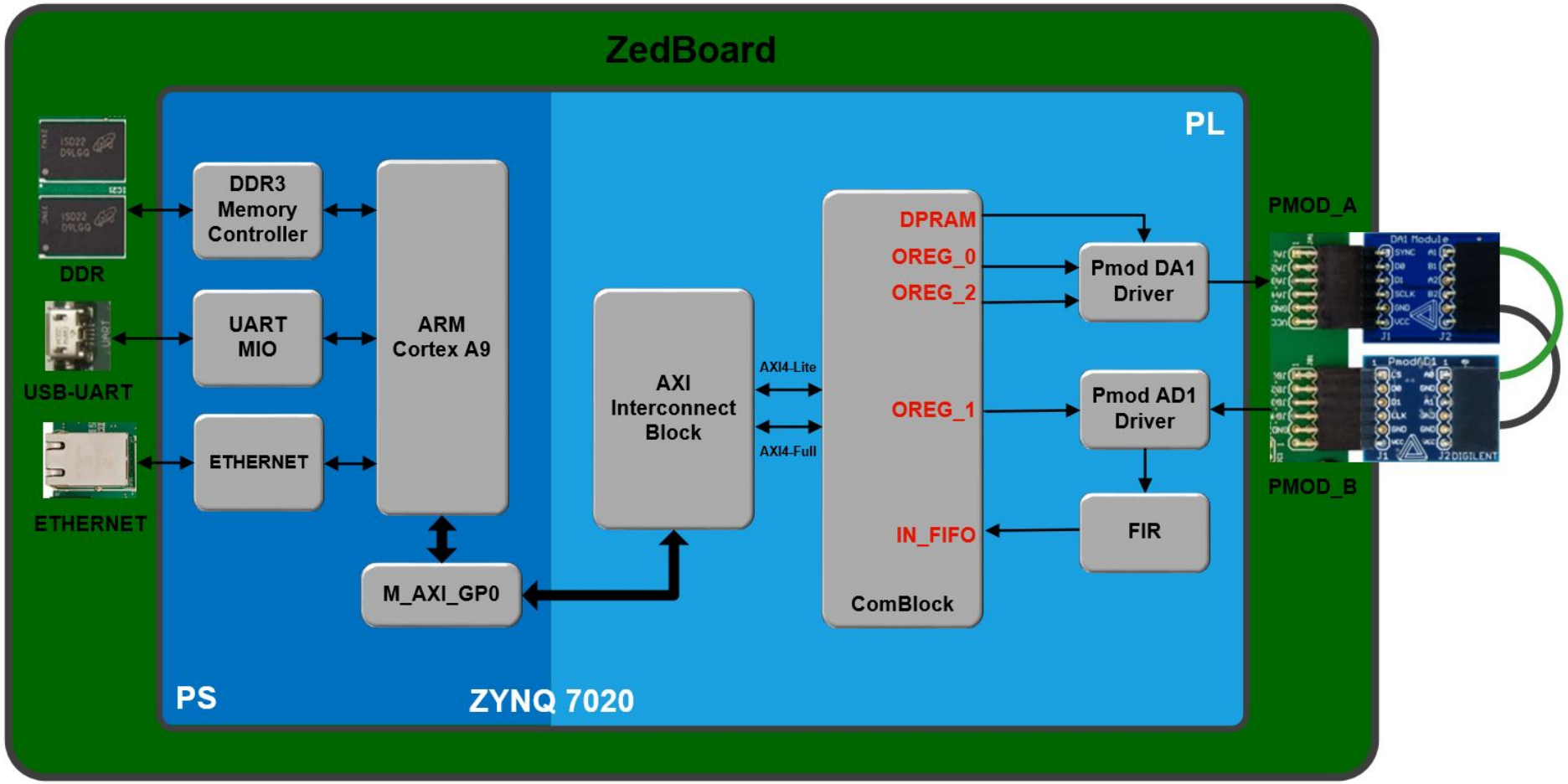
- Integrate PMOD modules into the hardware design to control and acquire signals in the analog domain from the SoPC.
- Understand the benefits of a higher abstraction level when using the **UDMA** environment for interaction.

Design description



Learn how to work in a collaborative environment with version control tools, employing **tcl** commands for hardware recreation.

- Git-compatible text-based source code
  - Reproducibility
  - Collaboration
  - Reliability
  - Complex deployments

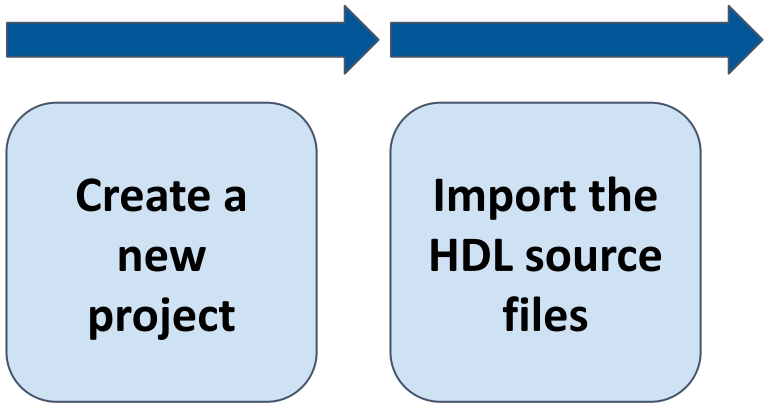
Using TCL to create a block design

Vivado - Hardware block design

Create a new project

Using TCL to create a block design

Vivado - Hardware block design



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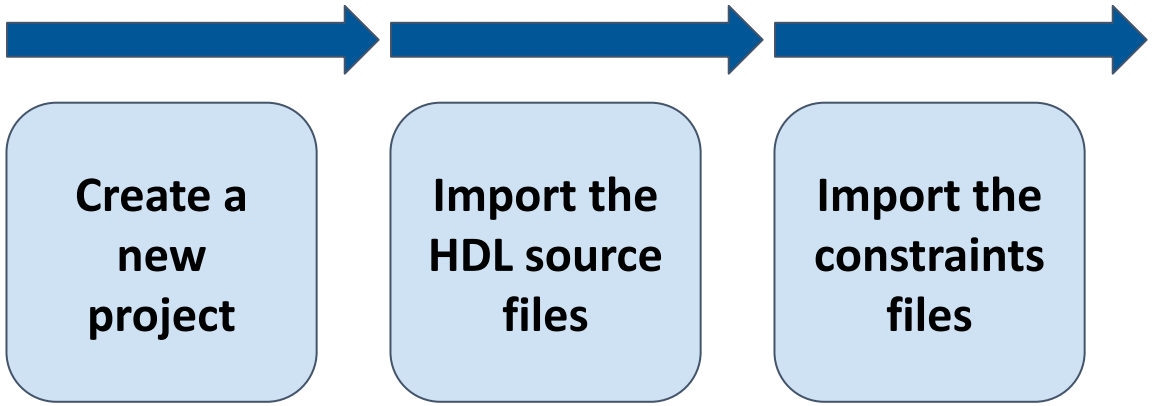

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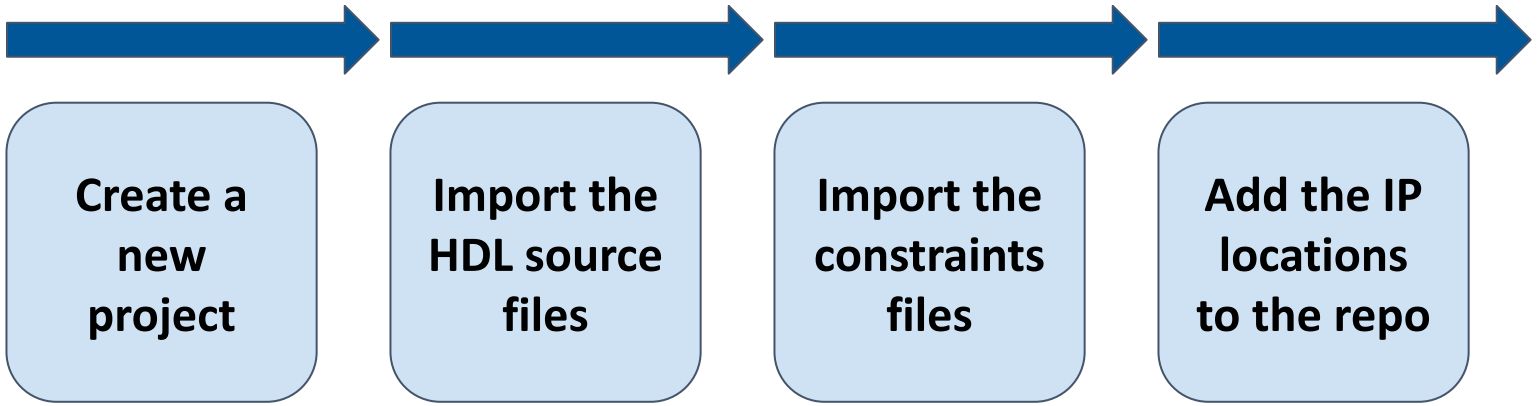

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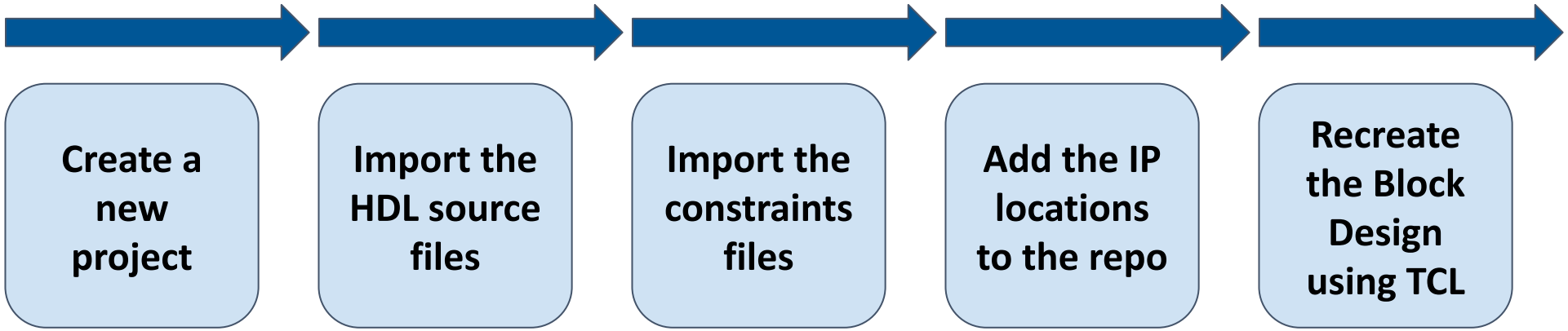

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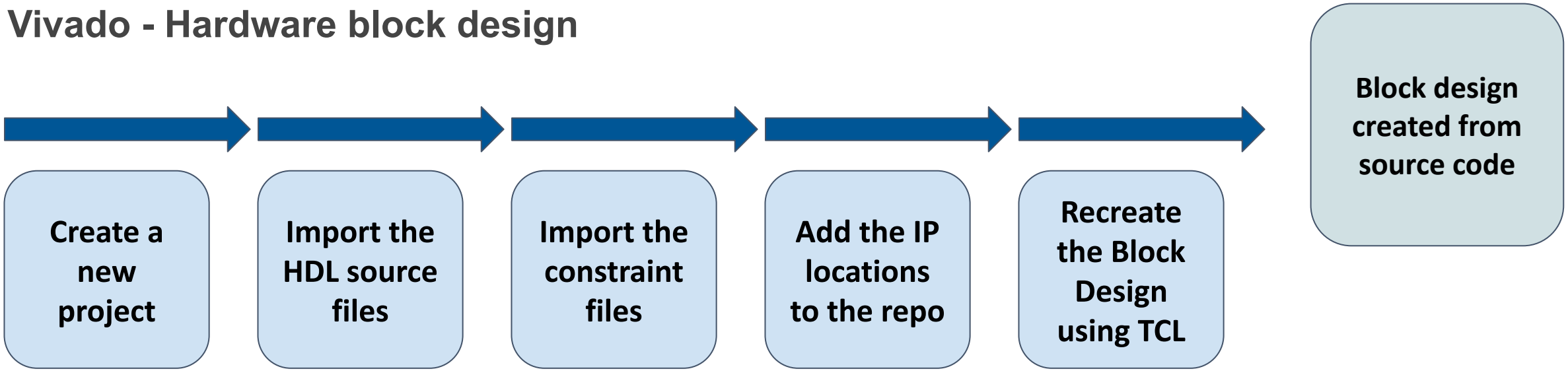
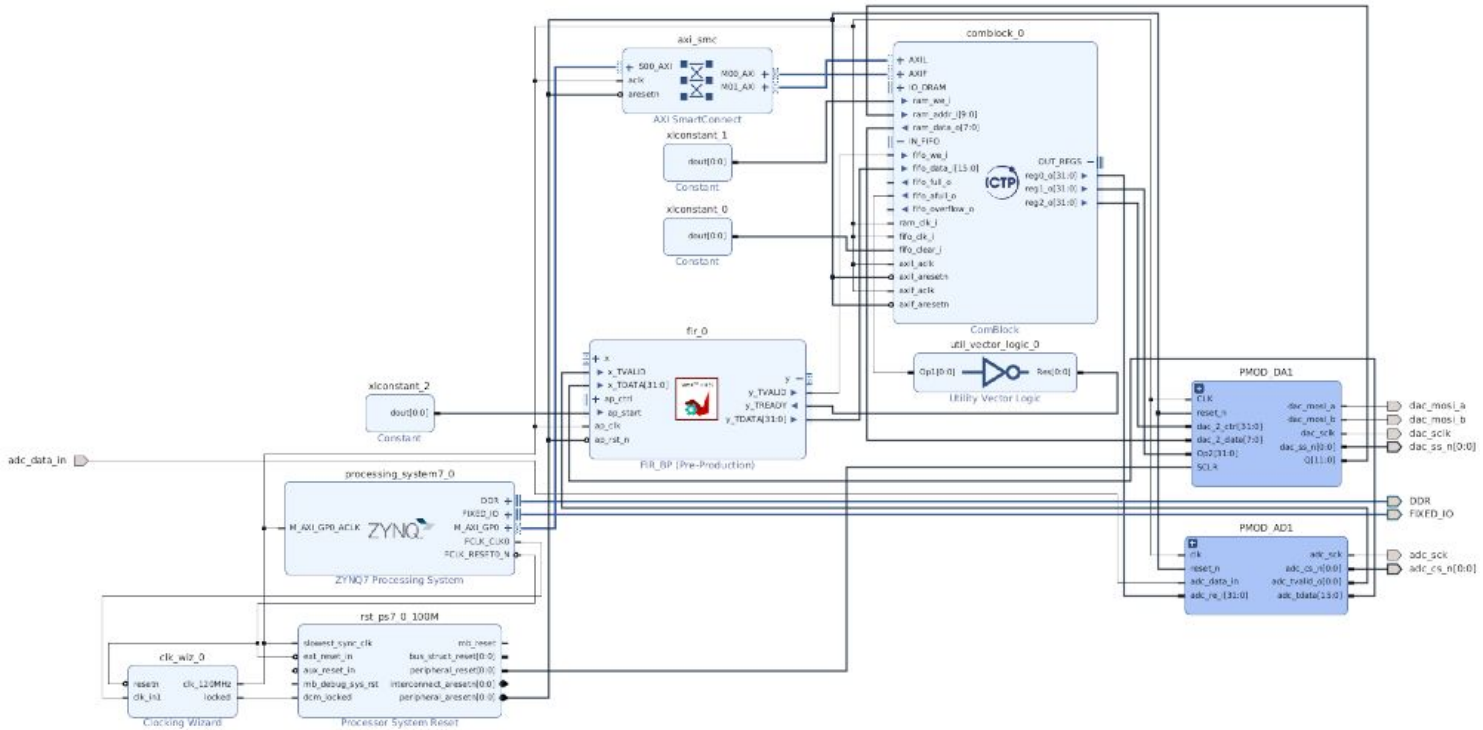


Using TCL to create a block design

Vivado - Expected block design



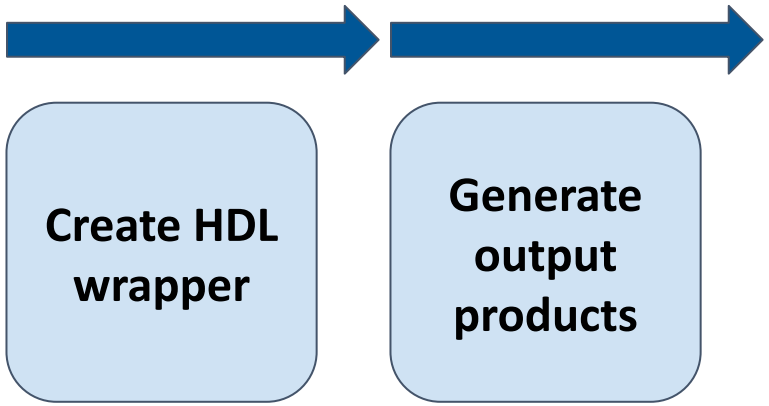
Creating the bitstream

From hardware block design to bitstream

Create HDL wrapper

Creating the bitstream

From hardware block design to bitstream



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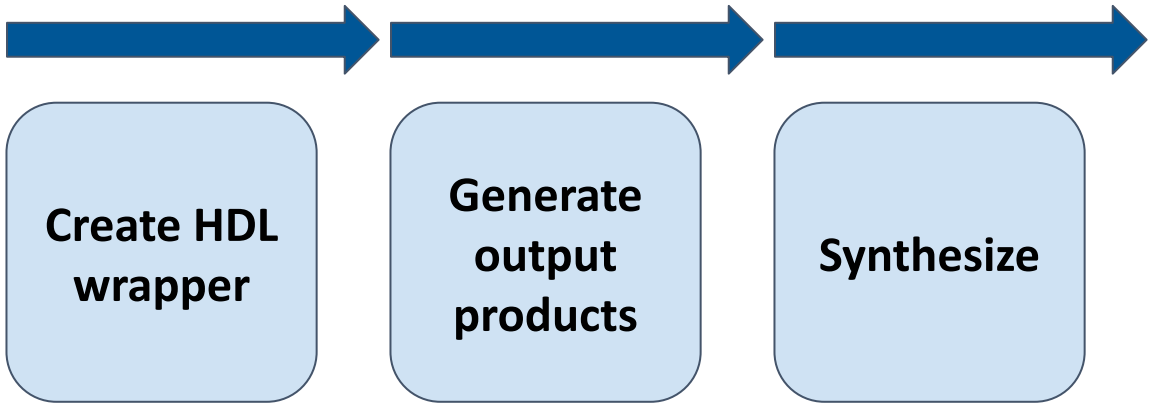

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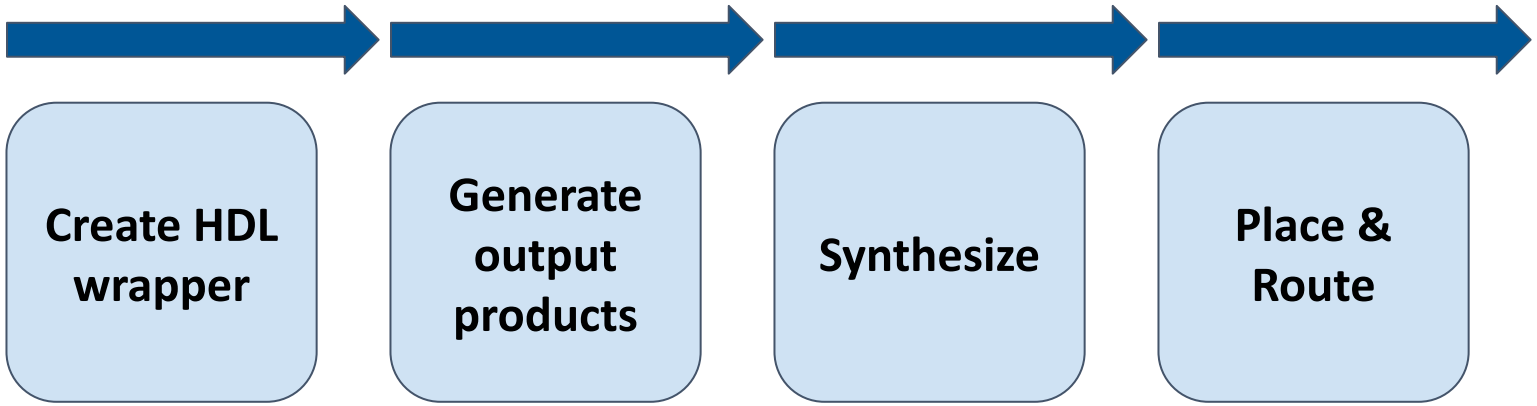

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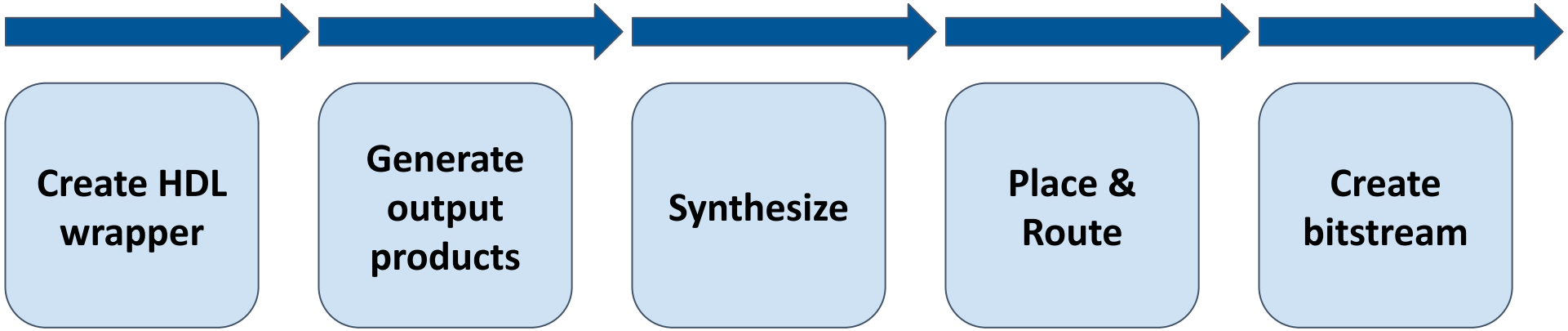

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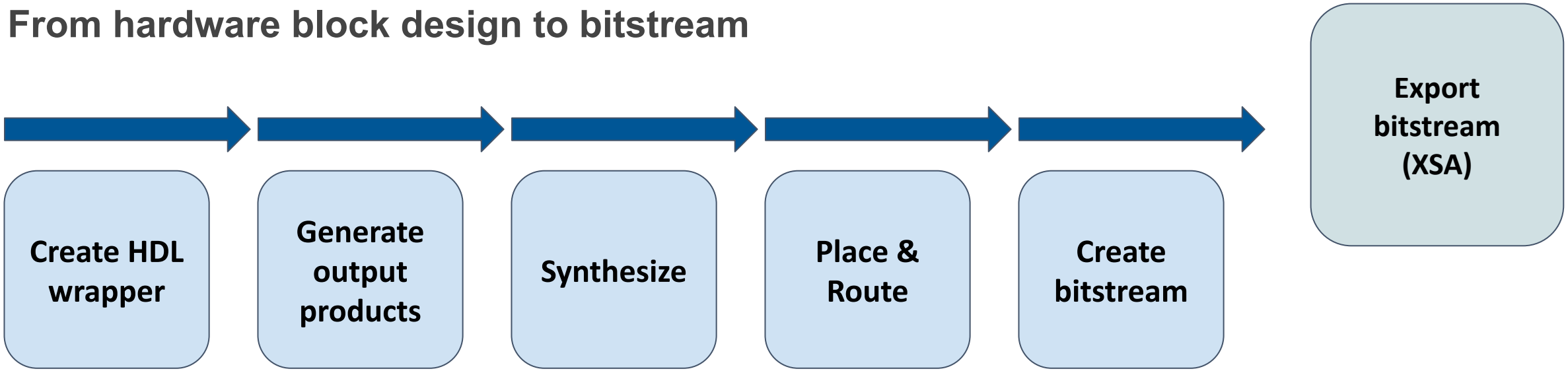
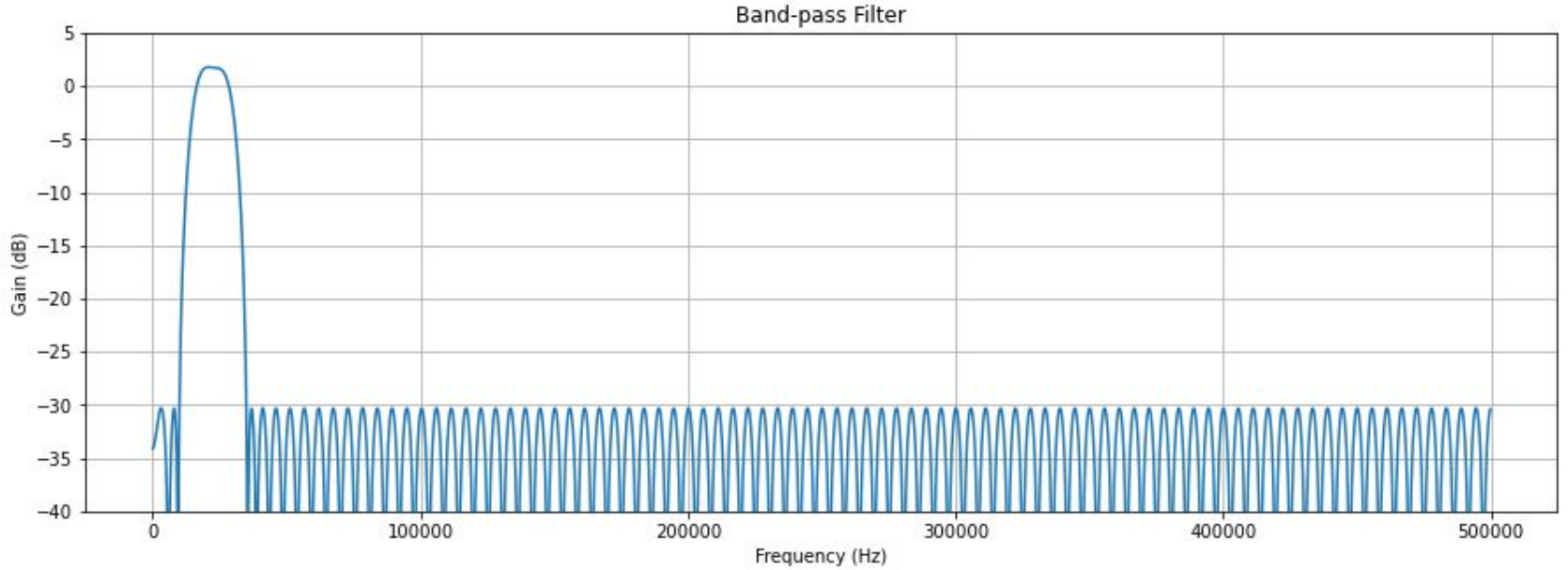


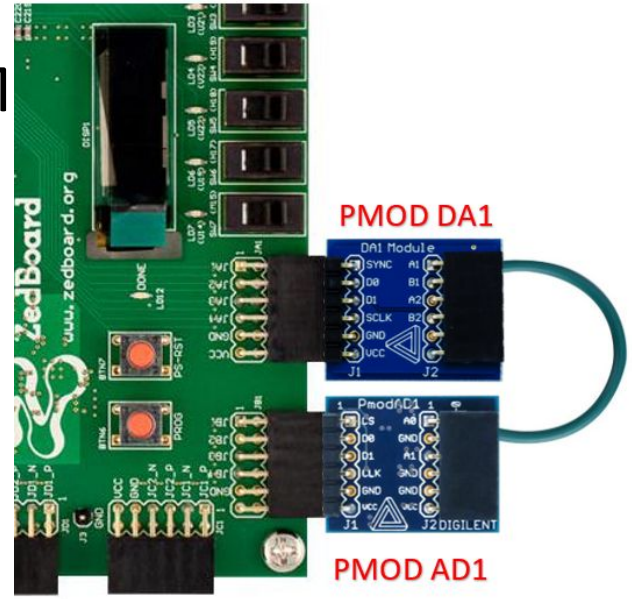
Perform the instantiation of an IP core previously designed through High-level Synthesis (HLS) tool.

- Finite-impulse response (FIR) bandpass filter implemented in HLS
- Instantiation in Vivado Block Design



Integrate PMOD modules into the hardware design to control and acquire signals in the analog domain from the SoPC.

- A/D and D/A Control - using ComBlock's output registers
  - Start conversion, data format
- D/A converter (1 Msps)
  - Arbitrary waveform generator using ComBlock's DP-RAM
- A/D converter (1 Msps)
  - Digitizing analog output from D/A (wire loopback)
  - Data acquisition using ComBlock's Input FIFO

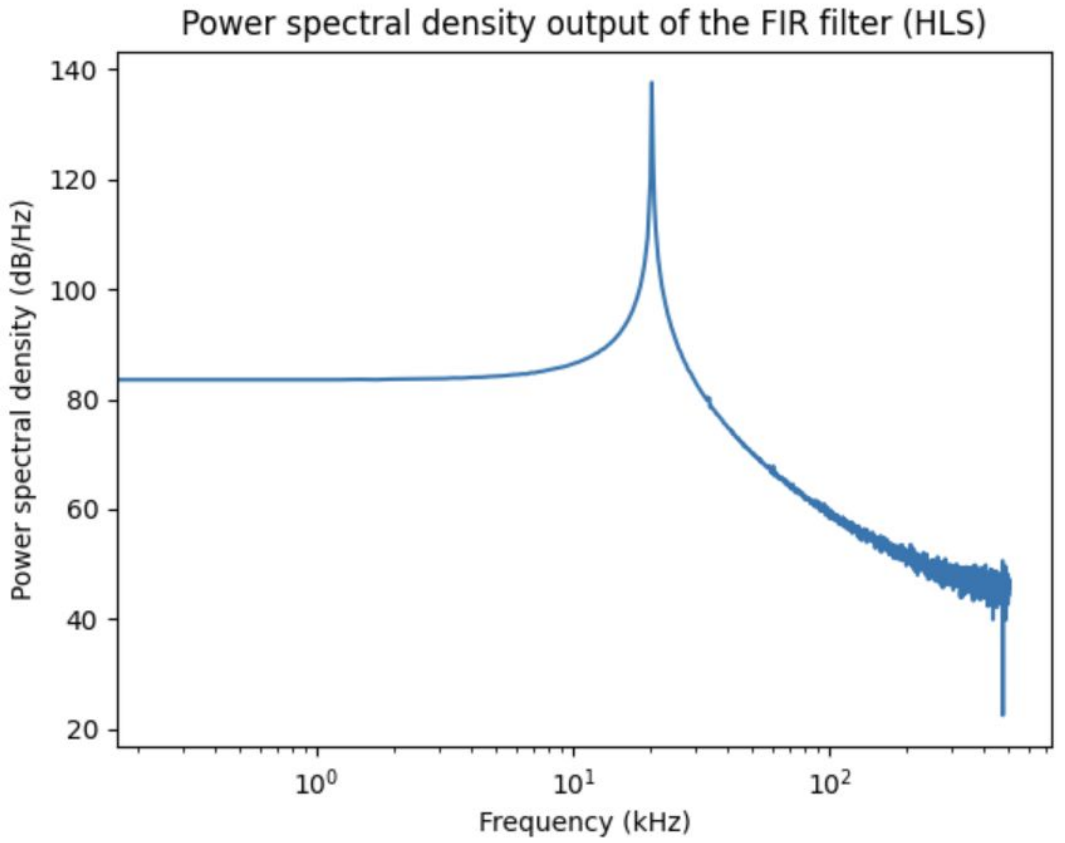


Understand the benefits of a higher abstraction level when using the UDMA environment for interaction.

- UDMA in Jupyter Notebook to interface the ComBlock in the PL remotely
  - Arbitrary waveforms from Python numeric libraries
  - Plotting and recording A/D data using Matplotlib (Python)
  - Using markdown to document within the Jupyter Notebook

Understand the benefits of a higher abstraction level when using the UDMA environment for interaction.

- Post-processing of recorded data in Jupyter Notebook
  - FFT of the bandpass filter response
- Challenges
  - Experimental bode plot
  - Changing HLS FIR filter response



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Thank you!

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