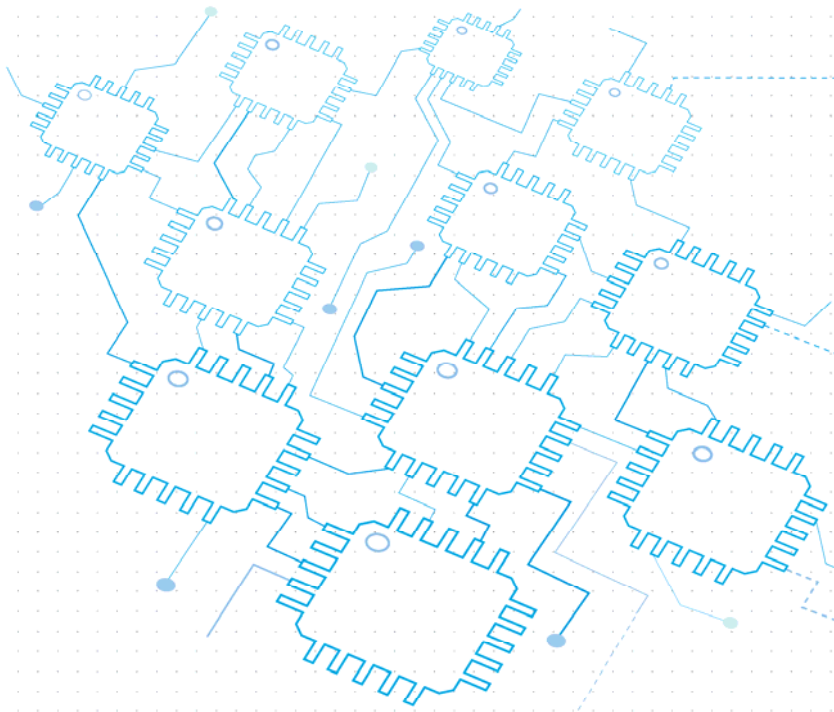




Academy of Sciences of the Czech Republic  
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# Development Kit for Xilinx PicoBlaze

Leoš Kafka

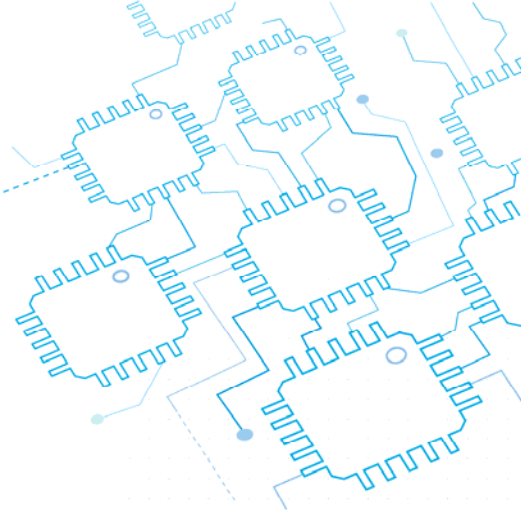
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# Presentation Outline

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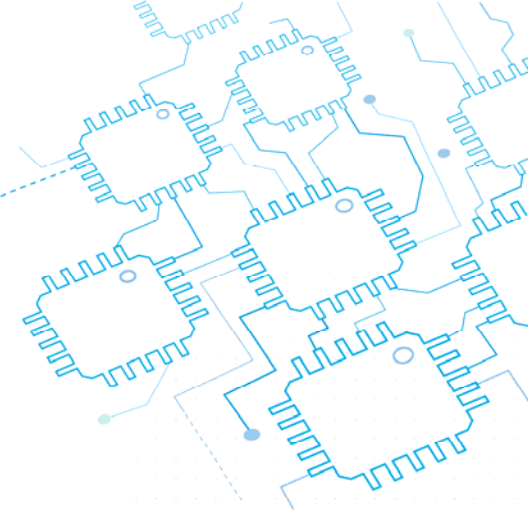
- ▶ **Xilinx PicoBlaze**
  - ▶ Features
  - ▶ Architecture
- ▶ **Design Flow**
- ▶ **Development Kit**
  - ▶ Requirements
  - ▶ Architecture



# PicoBlaze – Introduction

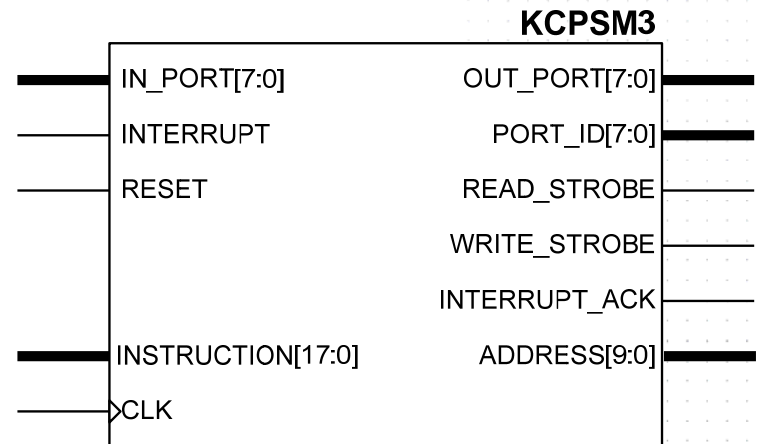
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- ▶ KCPSM3 – (K)constant Coded Programmable State Machine
- ▶ 8-bit microcontroller by Ken Chapman, Xilinx
- ▶ Soft-core for Xilinx Spartan-3(E), Virtex-II and Virtex-II PRO
- ▶ 96 Spartan-3 slices (10% of the XC3S100E)
- ▶ 50MIPS@100MHz
- ▶ Development tools: Mediatronix pBlazeIDE, kpicosim, PCCOMP



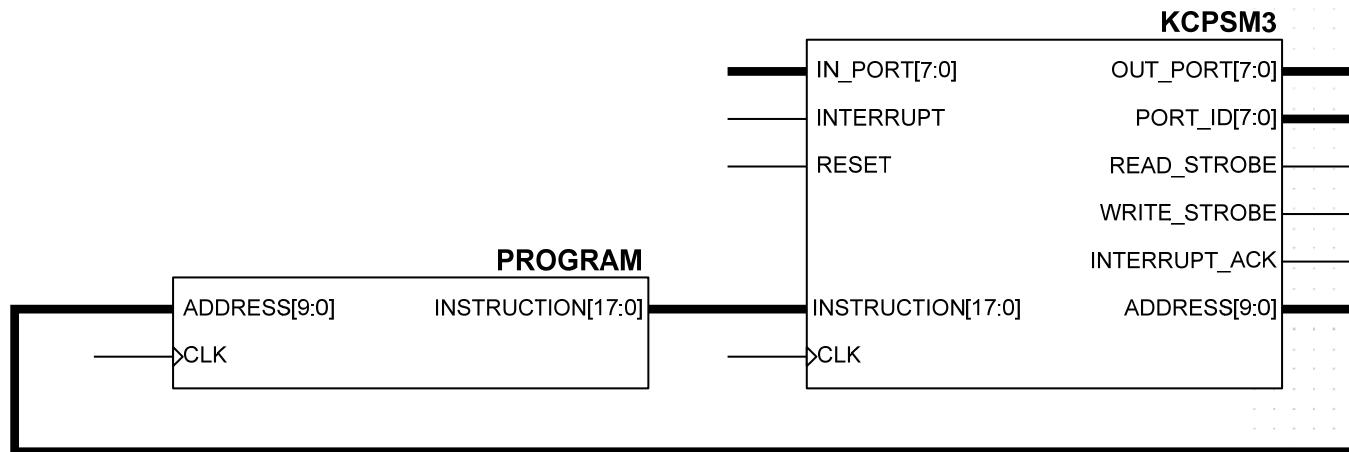
# PicoBlaze – Features

- ▶ RISC, Harvard architecture
- ▶ 16 general purpose registers
- ▶ 64B internal scratch pad memory
- ▶ 256 input and 256 output ports
- ▶ Single INTERRUPT input
- ▶ 31-level deep HW stack
- ▶ Program in BlockRAM
- ▶ Program length up to 1024 instructions



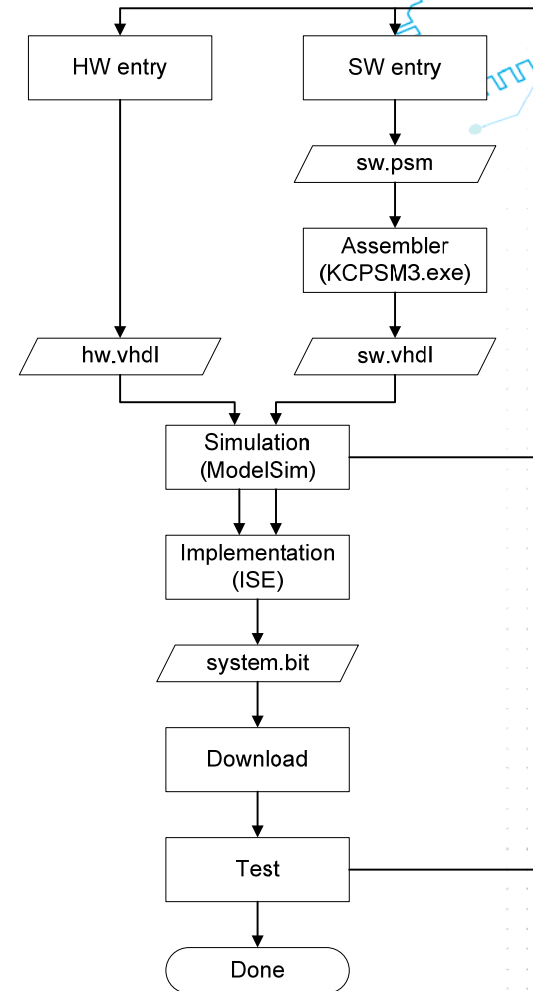
# PicoBlaze – Instruction Memory

- ▶ 18Kbit BlockRAM instantiated in the design
- ▶ BlockRAM content defined by the assembler
- ▶ One port of the BlockRAM is used for the PicoBlaze core, the second port is not used



# Original Design Flow

- ▶ HW definition is an integral part of the PicoBlaze based design
- ▶ PicoBlaze program is just another HW component (Block RAM with predefined content)
- ▶ Any modification of the PicoBlaze program requires to re-run the whole implementation flow



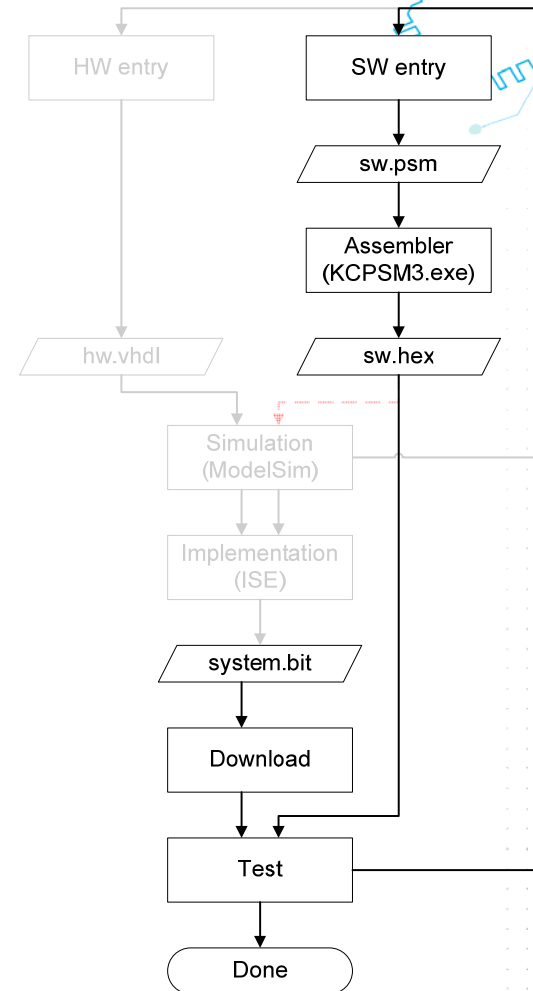
# Development Kit – Requirements



- ▶ Simple update of the PicoBlaze program
  - ▶ Remove the necessity of repeated implementation of the whole FPGA design
- ▶ High-level access to the I/O peripherals
  - ▶ Shield the user from low level control of the peripherals
  - ▶ Allow the user to rely on the proved hardware
- ▶ Independence of the used board
  - ▶ Xilinx FPGA (Spartan-3(E), Virtex-II or Virtex-II PRO)
  - ▶ UART and PS/2 interfaces, HD44780-based LCD display

# Proposed Design Flow

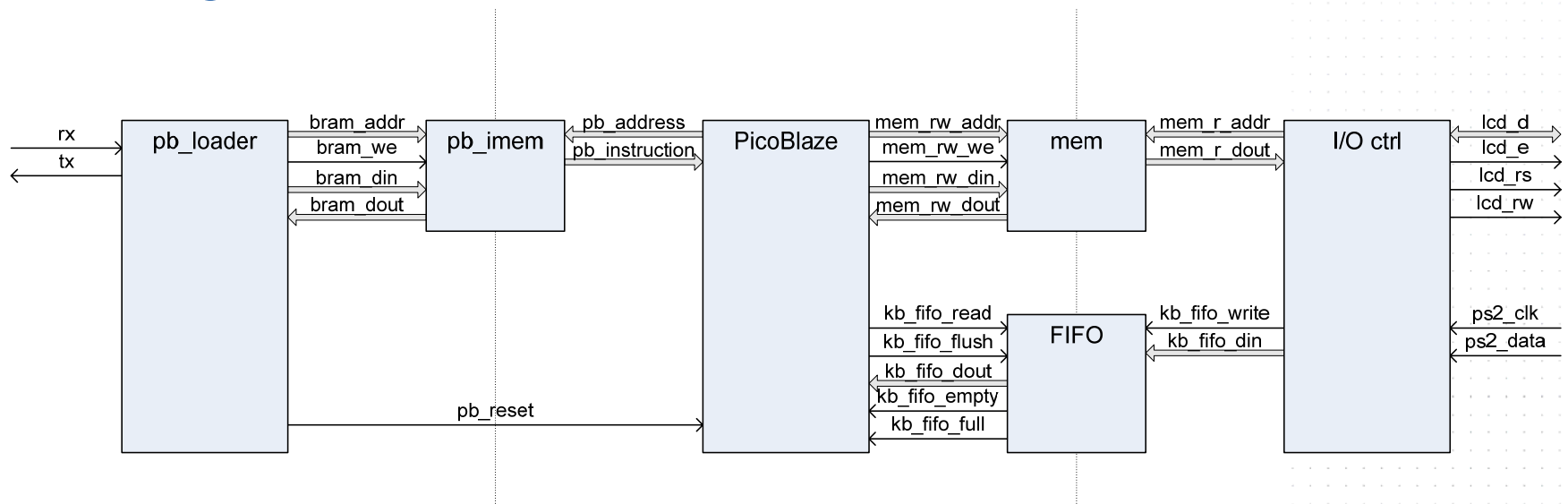
- ▶ HW is fixed
- ▶ Downloading the PicoBlaze program is a function of the base design
- ▶ PicoBlaze program is data used by the base design, not the part of the user design





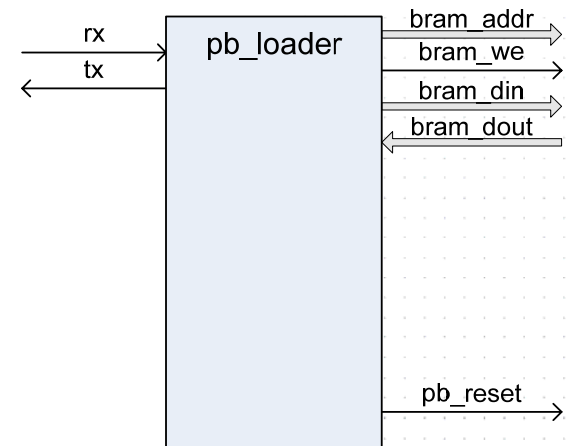
# Development Kit – Block Diagram

- ▶ Three main blocks based on PicoBlaze
  - ▶ pb\_loader, user PicoBlaze and I/O ctrl
- ▶ Communication between the components through shared memories and the FIFO

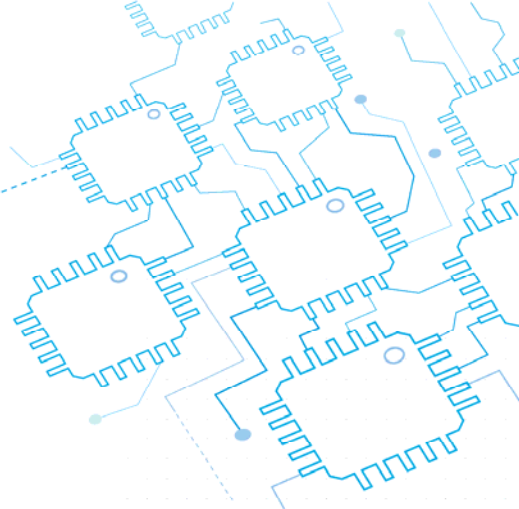


# Development kit – pb\_loader

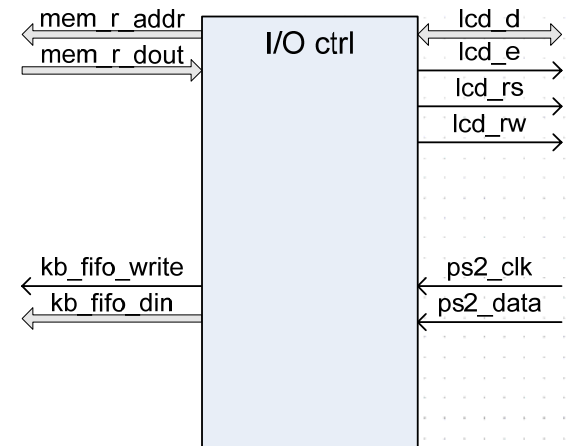
- ▶ Architecture:
  - ▶ PicoBlaze + I/O decoding logic
  - ▶ UART TX and RX macros (serialiser/deserialiser + FIFOs)
- ▶ Function:
  - ▶ Controlled through UART by software running on the host PC
  - ▶ Download/upload of the user PicoBlaze program
  - ▶ Reset of the user PicoBlaze



# Development Kit – I/O CTRL

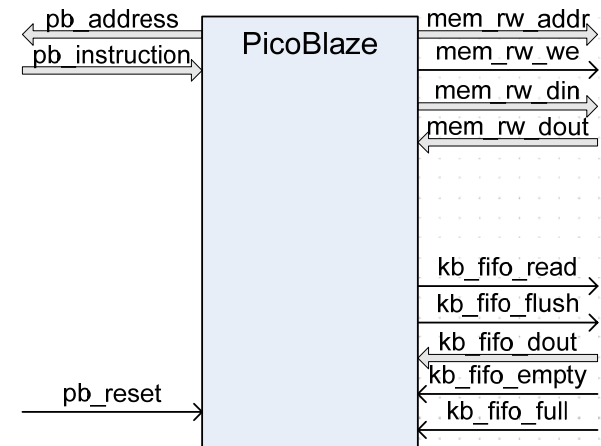


- ▶ Architecture:
  - ▶ PicoBlaze + I/O decoding logic
- ▶ Functions:
  - ▶ Controller of HD44780-based LCD display
    - ▶ Characters which are to be displayed read from memory
    - ▶ Cursor control (ON/OFF, blinking)
  - ▶ PS/2 keyboard controller
    - ▶ Read serial data from PS/2 keyboard
    - ▶ Push 8-bit scan-codes into the FIFO



# Development Kit – User PicoBlaze

- ▶ Architecture:
  - ▶ PicoBlaze + I/O decoding logic
- ▶ Function:
  - ▶ Memory mapped peripherals
    - ▶ “video RAM”
    - ▶ keyboard FIFO
  - ▶ IRQ when keyboard FIFO becomes non-empty



# Conclusions

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- ▶ The development kit for the PicoBlaze
- ▶ The development kit provides:
  - ▶ Simple and quick update of the PicoBlaze program
  - ▶ High-level access to the LCD display and PS/2 keyboard peripherals
- ▶ The development kit can be used:
  - ▶ to get familiar with PicoBlaze and its assembler
  - ▶ as a building blocks for more complex designs

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