

Using an FPGA as a Prototyping Platform for Multi-core Processor Applications

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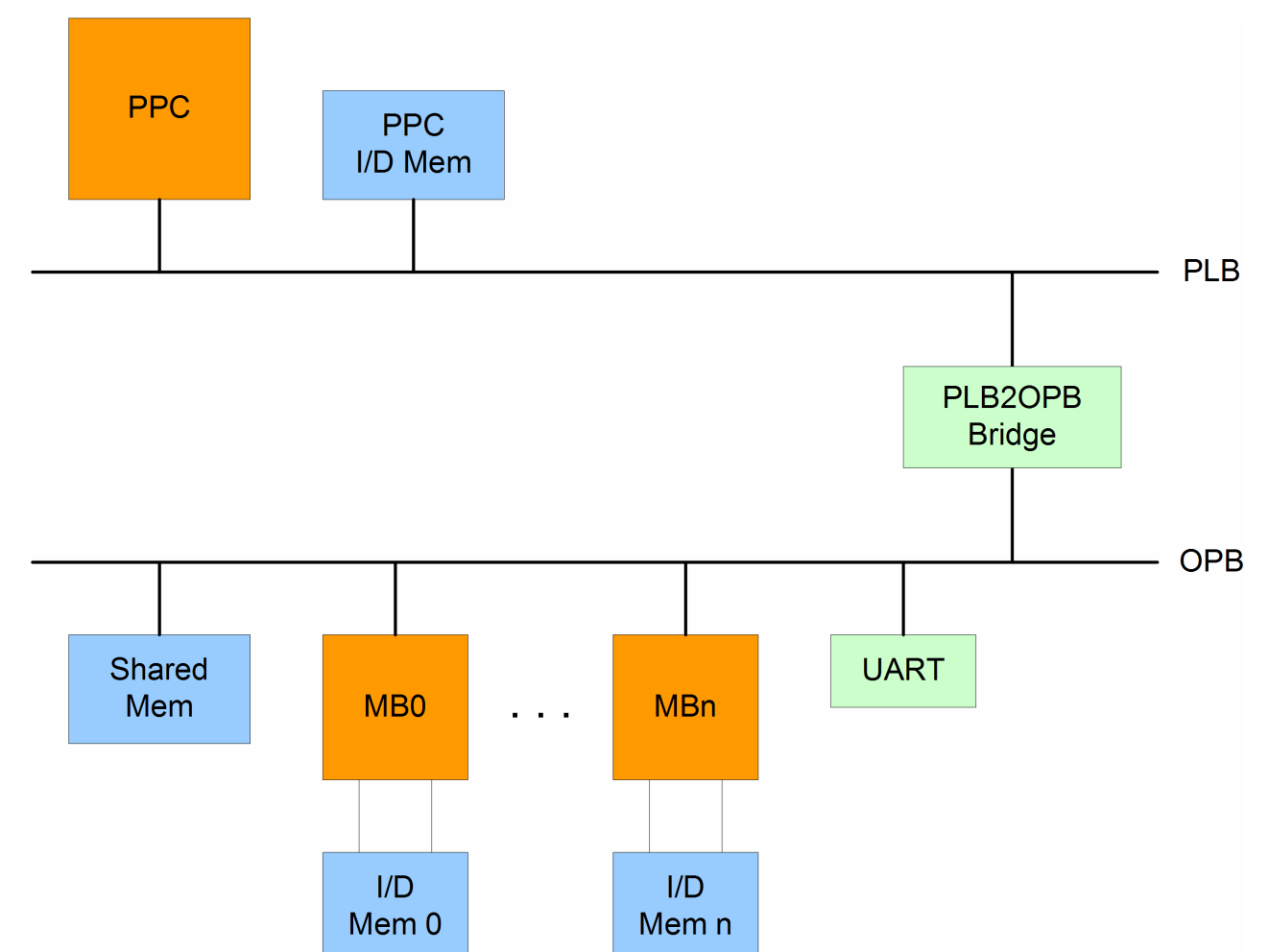
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Motivation

- **Future systems will use multi-core processors**
- **Build functional multi-core platform in an FPGA**
 - Enables systems and software testing
- **Explore benefits of processor extensions**

Multi-core Architecture

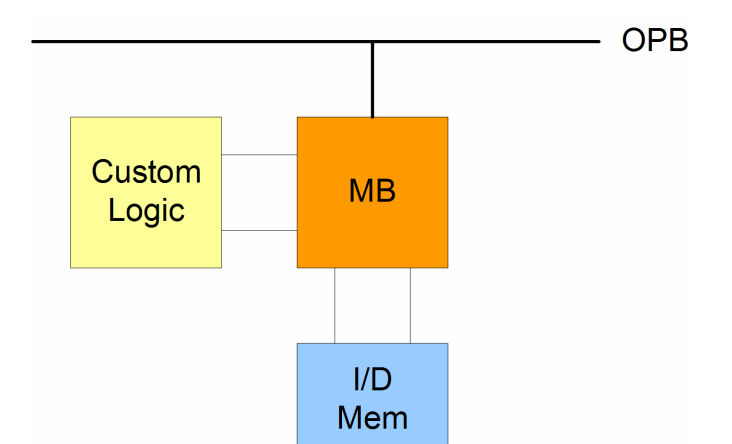


Sample App: DNA Sequencing

- **Task: Compare a single query sequence against multiple database sequences**
- **Single Program Multiple Data (SPMD) programming model**
- **PowerPC core manages work queue and synchronizes with worker MicroBlaze cores**
- **Measure execution time with various numbers of MicroBlaze cores**

Processor Extensions Using Custom Logic

- **Pattern-matching extension implemented in custom logic**
- **Attaches to MB core using FSL links**
- **Enhances software functionality by enabling longer sequence comparisons**



Results

Performance Scalability with Multiple Cores

Number of Cores	Execution Time (sec)	Speedup
1	23.89	1.0
2	11.94	2.0
4	5.96	4.0

Performance with Pattern-matching Extension

Length of Database Sequences	Execution Time (sec)		
	1 Core	2 Cores	4 Cores
128	47.93	23.99	12.00
256	57.78	28.92	14.40
512	115.6	57.73	28.92

Conclusions and Future Work

- **FPGA test-bed is useful for application prototyping for multi-core systems**
 - Functional validation of software
 - Explore trade-offs between software and hardware extensions
- **Future plans**
 - Implement heterogeneous core designs
 - Execute complete benchmarks under OS environment
 - Investigate other programming models (eg. MPSD, MPMD)