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An FPGA-based Multiprocessor System for BLAST Algorithm

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Outline

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- **Introduction**
 - BLAST-n Software
 - Multiprocessor Platform
 - Results
 - Conclusion / Future Work

Introduction (1/2)

- Basic Local Search Alignment Tool or BLAST is an algorithm for comparing primary biological sequences.
- Many software and hardware approaches have been introduced.
- Today, we can create soft-core multiprocessor systems with the use of FPGAs; this approach has several advantages :
 - ❑ reduce the design-time for a specialized hardware system
 - ❑ increase the flexibility of the design since the processing is done in software

Introduction (2/2)

- In this work we introduce a new approach to the implementation of the complex BLAST algorithm with the use of FPGA and soft-core processors:
 - ❑ Creation of a network of 14 Xilinx Microblaze soft-core processors
 - ❑ Each one of them solves the BLAST-n algorithm
 - ❑ All processors compare at the same time, the same query with a different part of the database
- The purpose of this work is:
 - ❑ to create a system that utilizes the advantages of FPGAs and soft processors
 - ❑ to increase the runtime performance and the throughput of the custom BLAST software implementation

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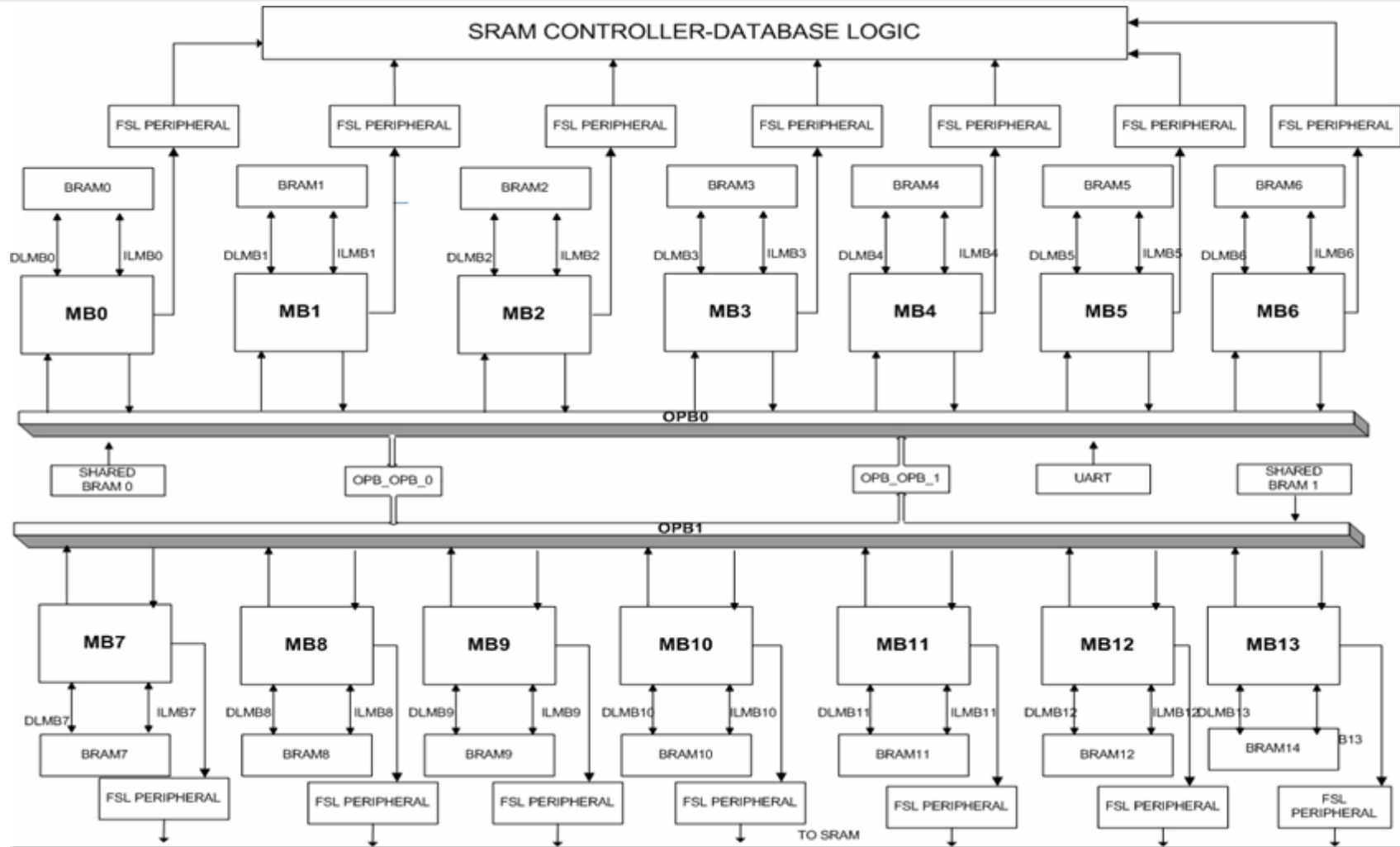
BLAST-n Software

- In this work BLAST-n software is chosen
- BLAST-n software parameters:
 - ❑ w-mer size: 12 sequences
 - ❑ Query size: 1000 sequences
 - ❑ Small database size
- Results not exactly the same as the one taken from NCBI software (due to optimizations and statistical manipulations)

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Multiprocessor Platform(1/2)



Multiprocessor Platform(2/2)

- The platform was designed with Xilinx tools EDK and ISE on a Virtex-II Pro FPGA
- The Multiprocessor Platform consists of:
 - ❑ 14 soft core Xilinx Microblaze processors
 - ❑ an external 4MB SRAM
 - ❑ some other library and custom peripherals
- Each processor:
 - ❑ runs the custom BLAST-n software
 - ❑ compares the same query with a different part of the database
- The database:
 - ❑ is stored in the external SRAM
 - ❑ is divided among the processors

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Results

- Speed on a Virtex-II Pro FPGA: 96.49 MHz
- Results (from initial measurements):

System	Throughput (char/sec)
3.2 GHz Intel P4	244.52
Multiprocessor Platform	4847.55

- Estimated Speedup : 19.86

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Conclusion / Future Work

- Conclusions:
 - ❑ Low cost approach opposed to ASIC or VLSI solutions
 - ❑ High performance
 - ❑ Easily reconfigurable :only the software has to be changed
 - ❑ Extendable : many FPGAs can be connected together
 - ❑ Cheap transition to new technology FPGAs
- Future work:
 - ❑ Increase the number of processors (up to 256)
 - ❑ Download and evaluate the results on a board
 - ❑ Performance comparison with other BLAST implementations

THANK YOU!

QUESTIONS?