Heterogeneous High-Performance Computing

Paul Chow

http://www.eecg.toronto.edu/~pc

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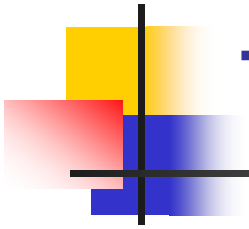
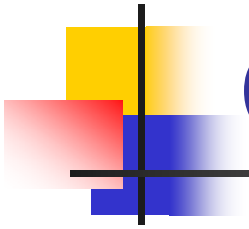


Today's Issues

- Uniprocessor performance has slowed significantly
- Heat is the issue
- Microprocessors are going multi-core
- Parallelism does not solve all problems

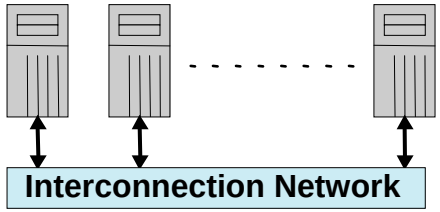


Other Approaches

- Heterogeneity
- More customized solutions can be faster and more efficient
  - But less general
- Clearspeed, vector, Cell, GPU
- FPGAs

Background: Classes of HPC Machines

- Class 1 Machines
  - Supercomputers or clusters of workstations



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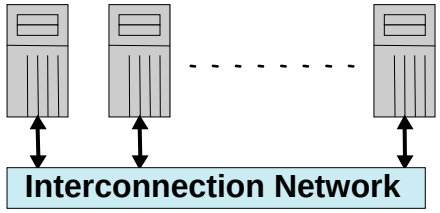
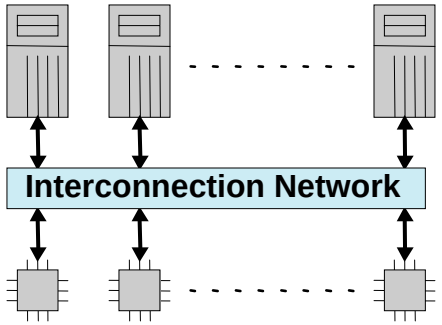


- Class 2 Machines
  - Hybrid network of CPU and FPGA hardware
  - FPGA acts as external co-processor to CPU



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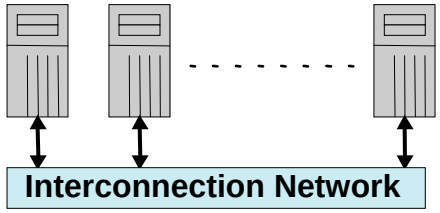

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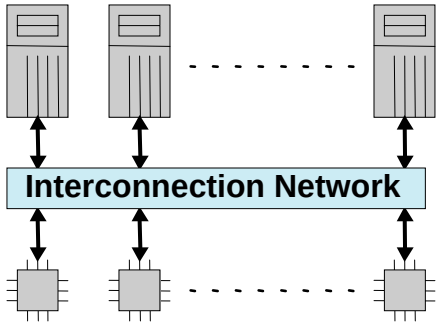
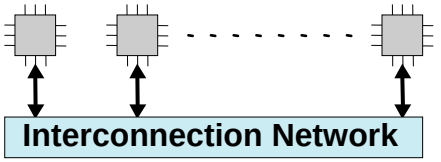
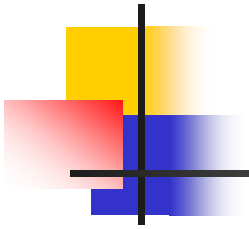


- Class 3 Machines
  - FPGA-based multiprocessor
  - Recent area of academic and industrial focus

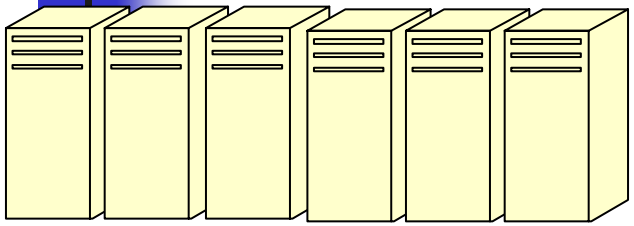


What are the Architecture Issues?



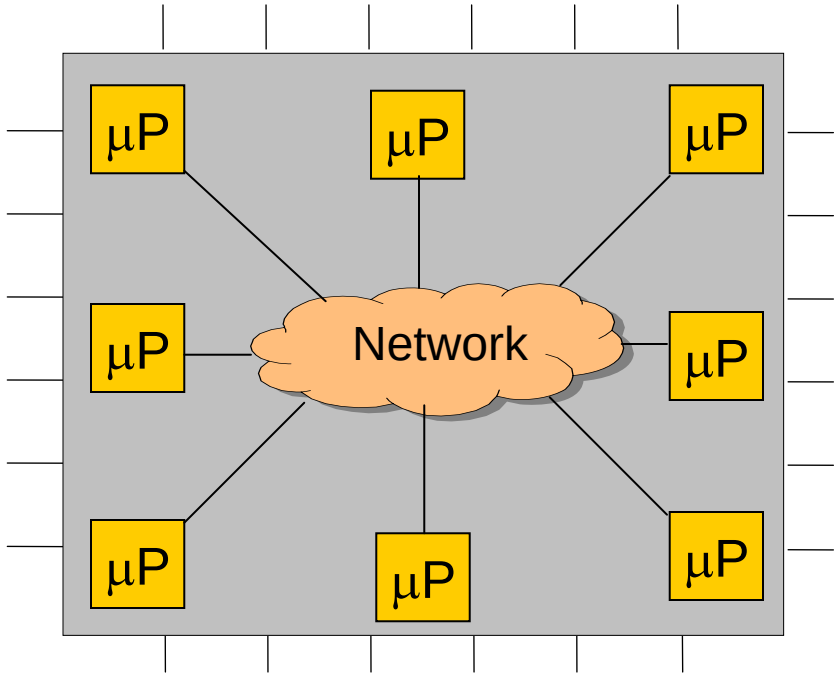
- Interconnect between FPGA and processors (Class 2)
  - Custom and commodity
  - HyperTransport (AMD)
    - XtremeData, DRC, Celoxica
  - PCIe, FSB

The TMD Machine (Class 3)



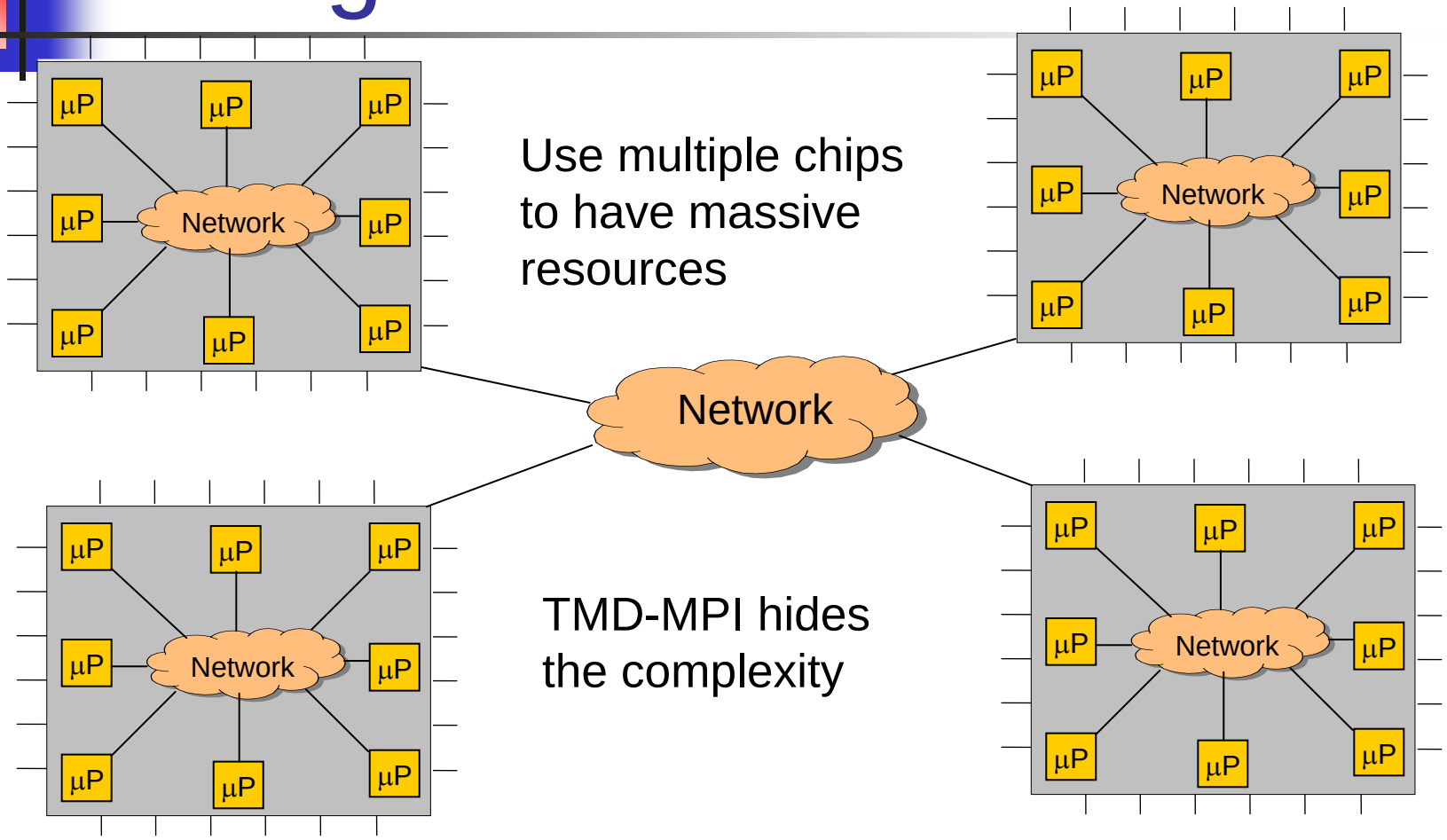
Linux Cluster
(MPICH)

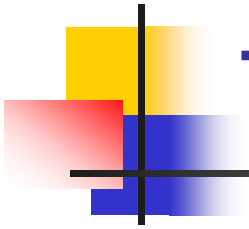
MPSoC
(TMD-MPI)



the same code…

Background: TMD-MPI





The Research

- Map applications
- What are the issues?
- Model
- Better solutions
- How do you program these things?