A Comparative Study on Heterogeneous and Homogeneous Multiprocessors

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Presentation's contents

- What is a multicore processor?
- Types of multicore processor.
- Performance heterogeneity.
- Intel and AMD Dual-Core processors.
- Cell processor.
- Tilera TILER64.
- Challenges.
- Conclusions.

What is a multicore processor?

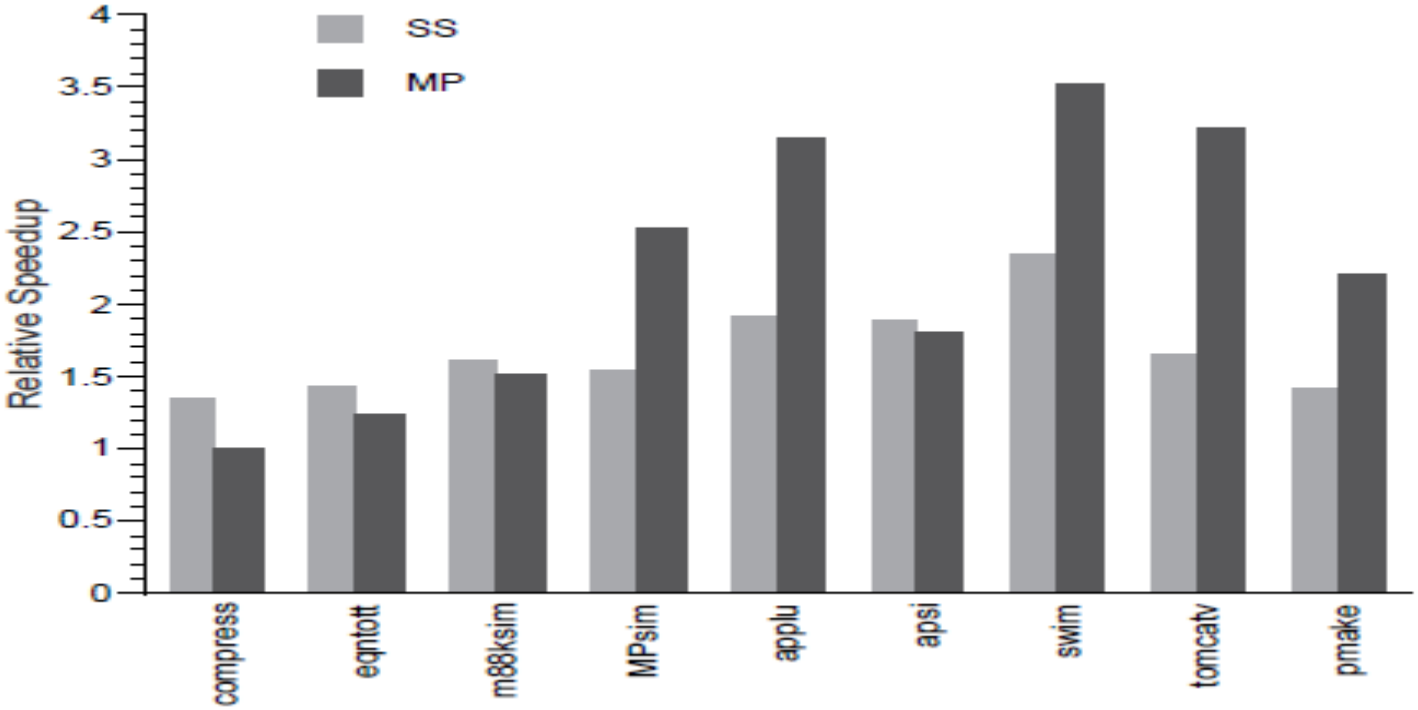
- A multicore processor: is processor which has a multiple cores integrated on a single chip.
- The driving forces for increase interests in multicore trend:
  i. The need for machine with higher performance and computational power.
  ii. The increase in complexity in the design of uniprocessor.
  iii. Improve system throughput and reducing processor power.

Types of multicore processor

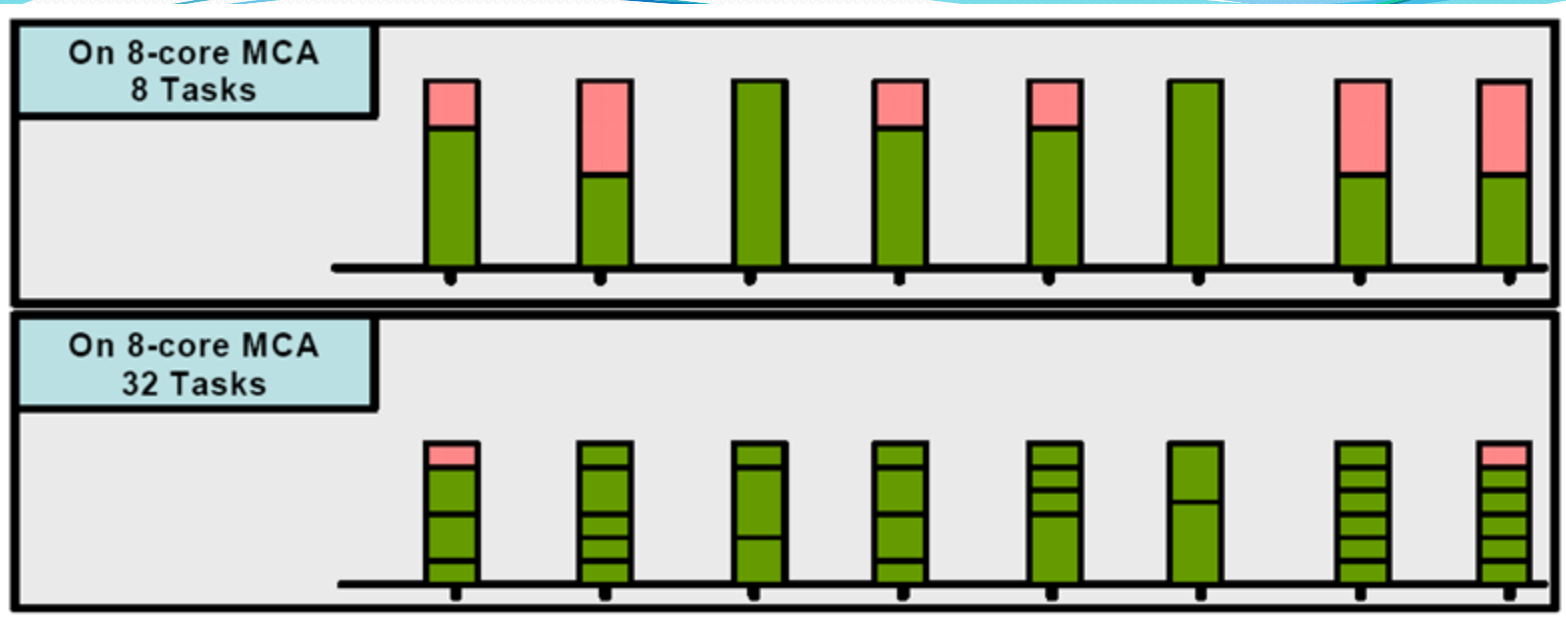
- **Homogeneous multicores**: is a set of multicores where every core is an image of the other.
- **Heterogeneous multicores**: is a set of cores which may differ in area, performance, power dissipated … etc.

Performance heterogeneity

- From Amdahl's law we concluded that the serial execution plays an important part in overall system performance of the system.
- To efficiently utilize the performance potential of multicore processor the program must be broken into parallel set of tasks.

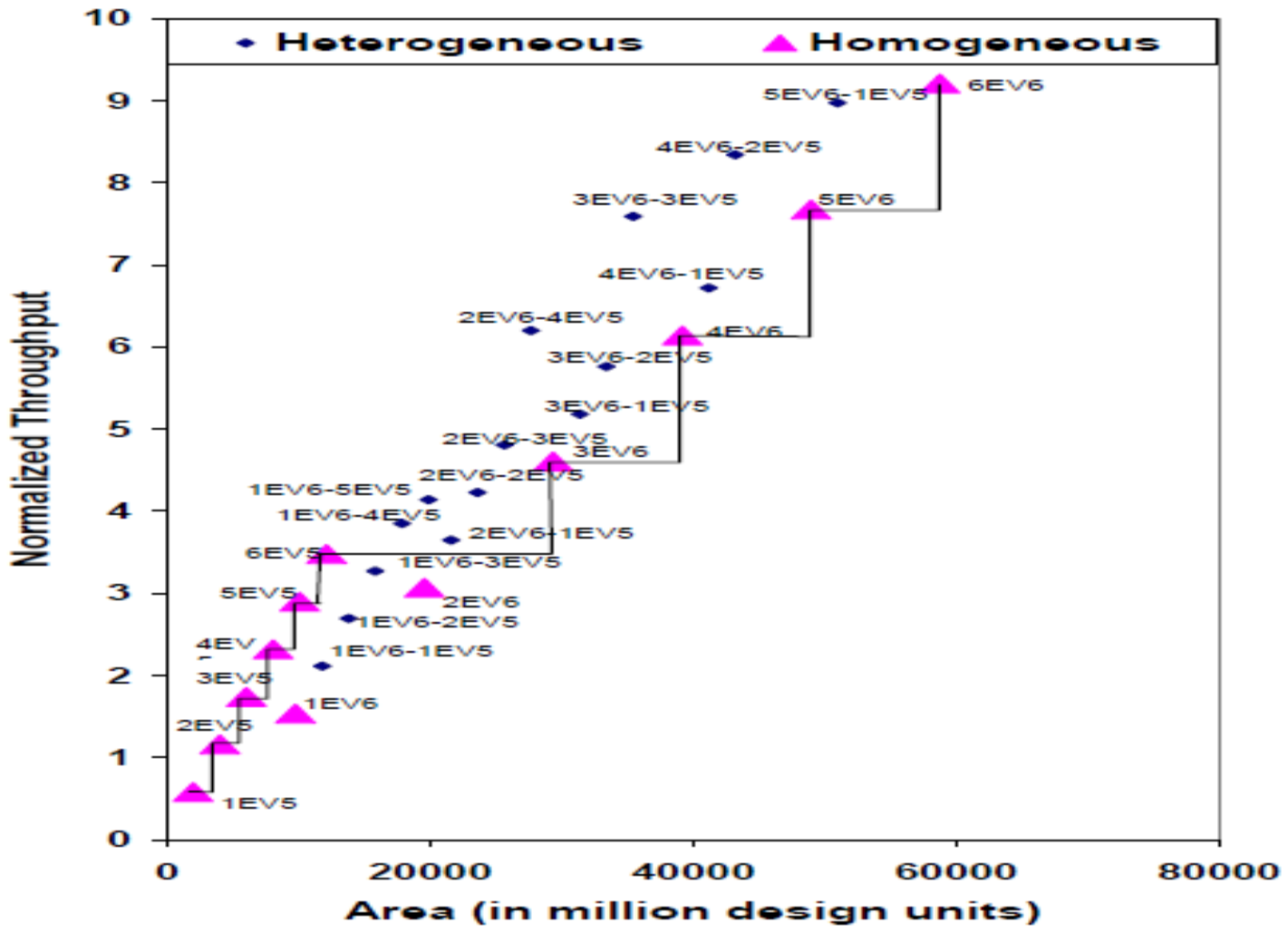


Performance comparison of superscalar and multicore processor



The impact of parallelism in multicore processor

The above figure shows that it is always desirable to have more number of parallel tasks than the number of cores.


Heterogeneous
Homogeneous
Normalized Throughput
Area (in million design units)
0
20000
40000
60000
80000
1
2
3
4
5
6
7
8
9
10
1EV5
2EV5
3EV5
4EV
5EV5
6EV5
1EV6
1EV6-1EV5
1EV6-2EV5
2EV6
1EV6-3EV5
2EV6-1EV5
1EV6-4EV5
2EV6-2EV5
1EV6-5EV5
3EV6
2EV6-3EV5
3EV6-1EV5
4EV6
3EV6-2EV5
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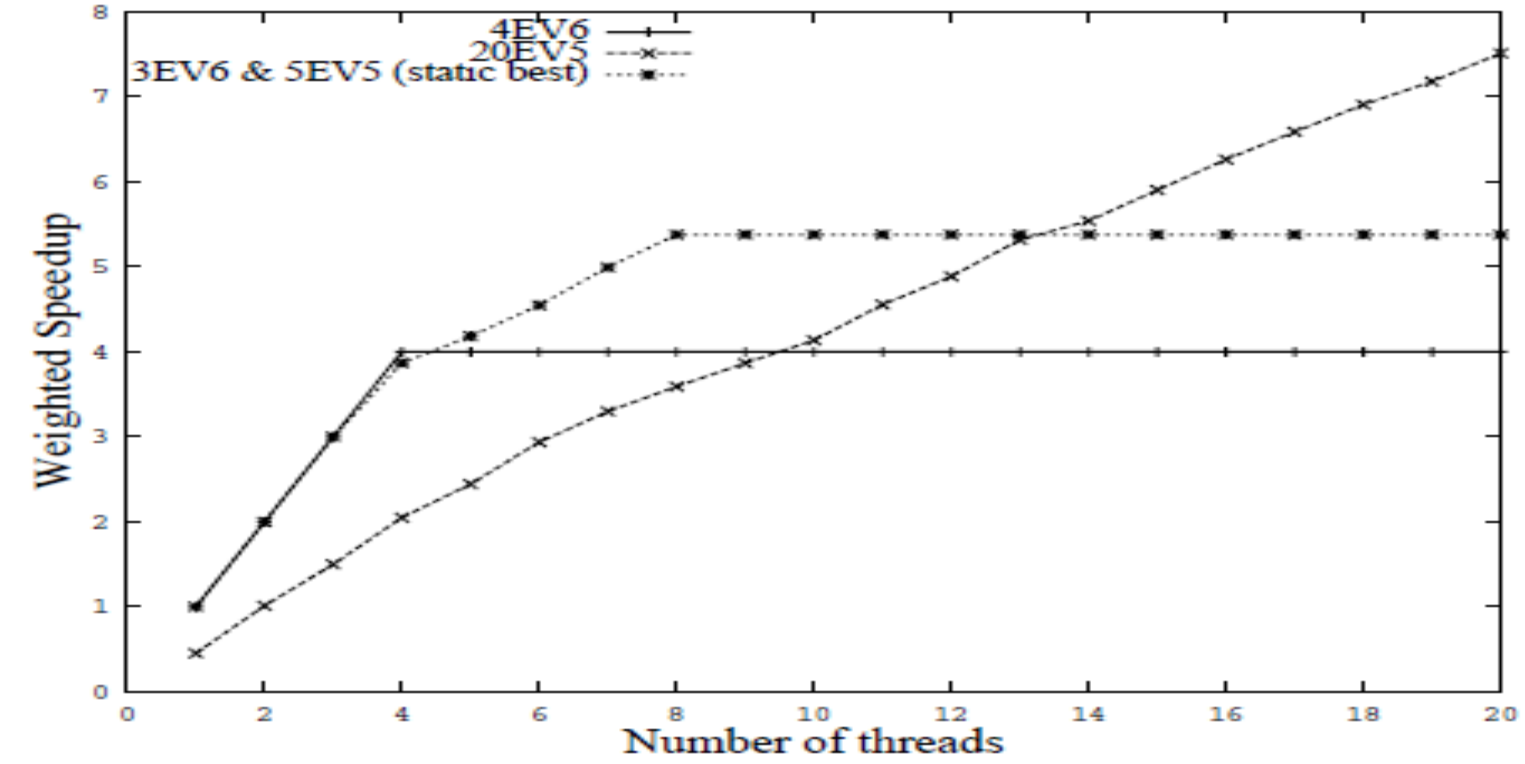
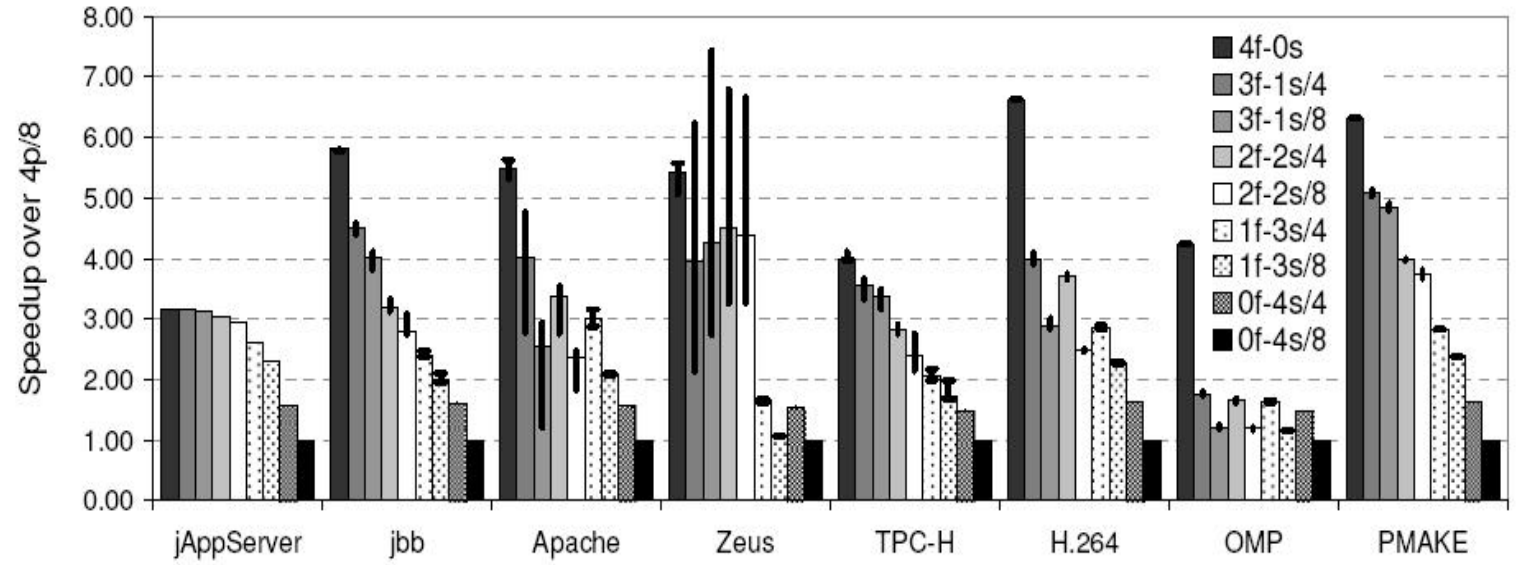
4EV6-2EV5
5EV6-1EV5
6EV6



Benefits from heterogeneity - static scheduling for inter-thread diversity.

- In a heterogeneous multicore system :many simple cores together provide high parallel performance while complex core help in providing high serial performance

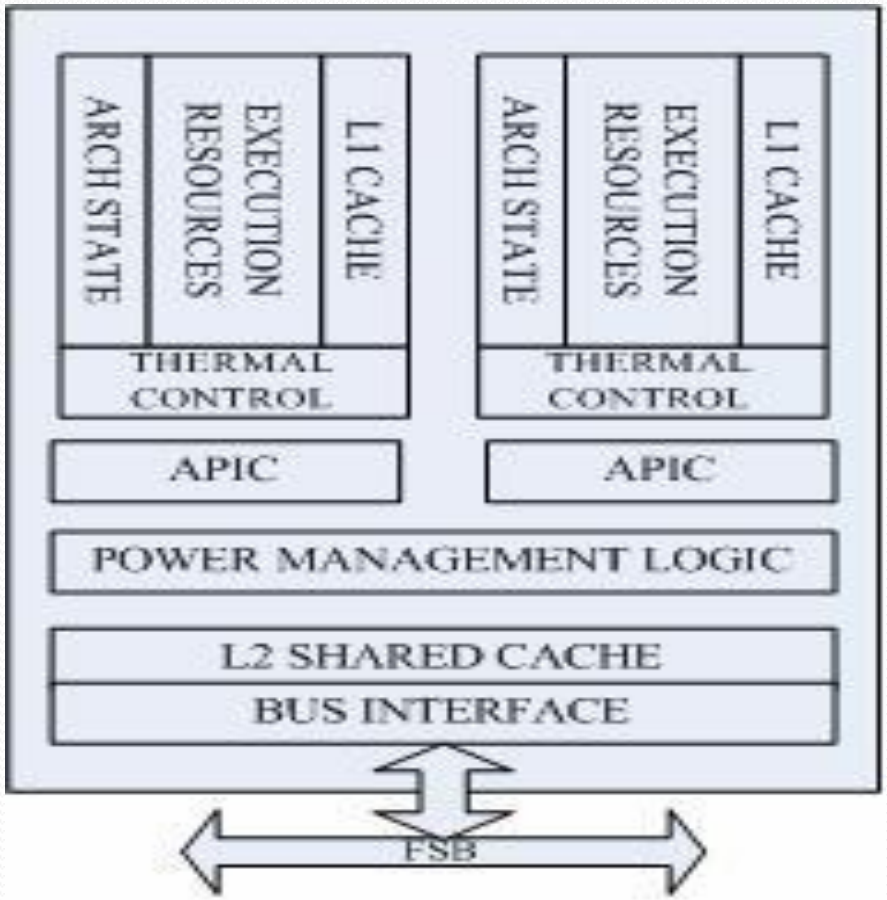


The superior performance of heterogeneous and homogeneous multicore processors.

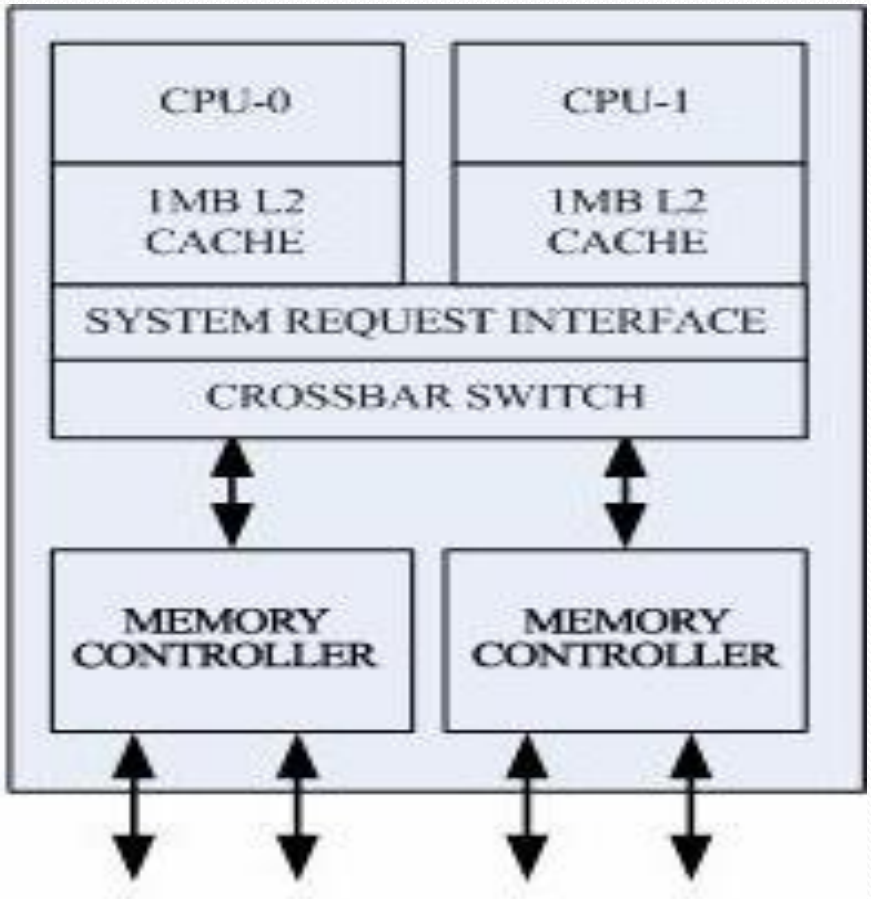
Recent development

- The manufacturers of multicore architecture have many variations, such as:
  - Communication and memory configuration.
  - How many cores the microprocessor has.

Intel and AMD Dual-Core processors

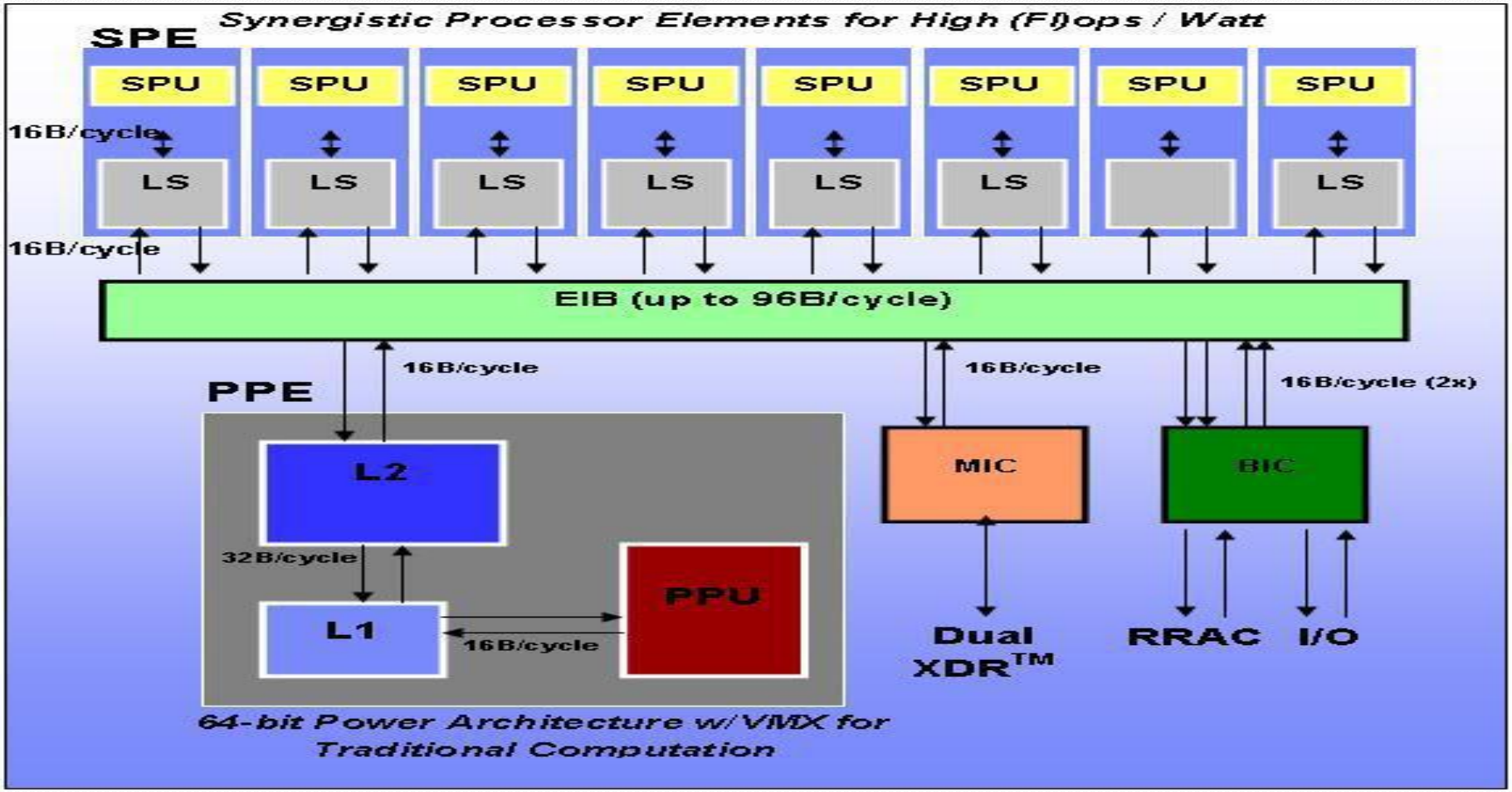


Intel core 2 Duo

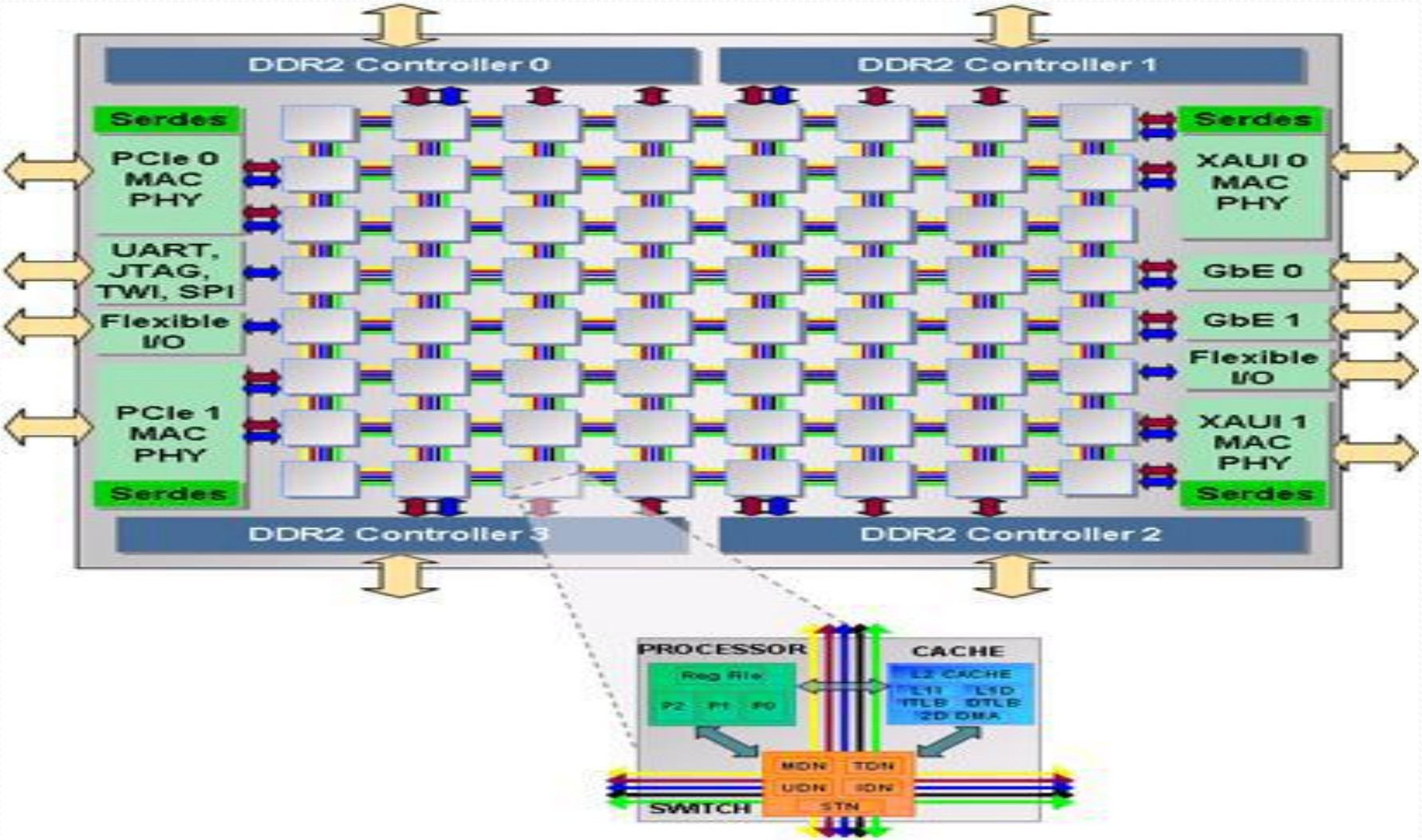


AMD Athlon 64 X2

Cell processor



Tilera TILER64



Challenges

- The greatest difficulty remains in teaching parallel programming techniques .
- Redesigning current applications to run optimally on a multicore system.
- The memory systems and interconnection networks also need improvement.

Conclusions

- Like the jump from uniprocessor to multiprocessors. Maybe soon, the term “transistor count” previously used to measure the microprocessors will become “processor count”.
- The advantages of Heterogeneous Chip Multicore processor clearly outweigh that of Homogeneous multicore.
- Many architects have studied whether the cores in a multicore environment should be homogeneous or heterogeneous, and there is no final answer…yet.

Conclusions

- There is an apparent trade-off between processor complexity and customization.
- Each core in a heterogeneous environment could have a specific function and run its own specialized instruction set. Depending on the CELL example, explained previously, a heterogeneous model could have a large centralized core built for generic processing and running an OS, a core for graphics, a communications core, an enhanced mathematics core, an audio core, and so on.

Thank you