

# Multicore

# Limitations of Single core ...

- Smaller transistors = faster processors.
- Faster processors = increased power consumption.
- Increased power consumption = increased heat.
- Increased heat = unreliable processors.

# Limitations of Single core...

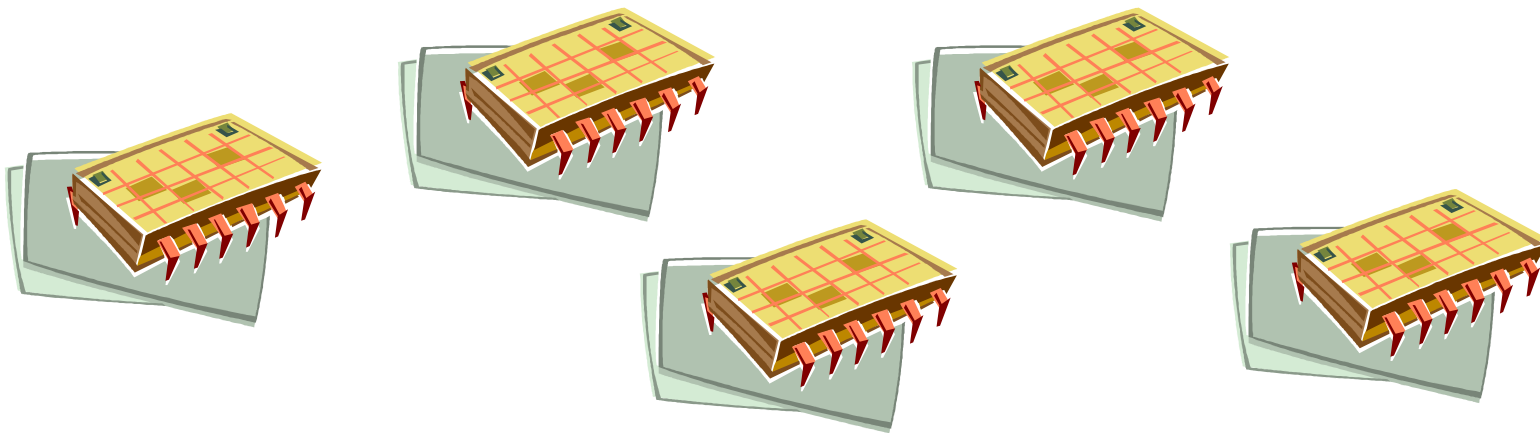
- A simple Thump rule is that
  - For every 1% rise in the clock frequency you will see 3% rise in the power consumption
  - Thus the heat dissipation also increases.

# Why Multicores ?

- Difficult to make single core clock frequency higher
- Many new applications are multithreaded
- General trend in Computer Architecture is shift toward more parallelism

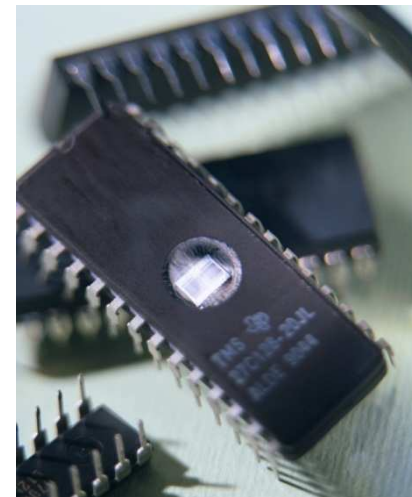
# Multicore Processors

- Instead of designing and building faster microprocessors, put multiple processors on a single integrated circuit.



# Multicore Processors

- Move away from single-core systems to multicore processors.
- “core” = central processing unit (CPU)
- Introducing parallelism!!!



# Multicore Architectures ...

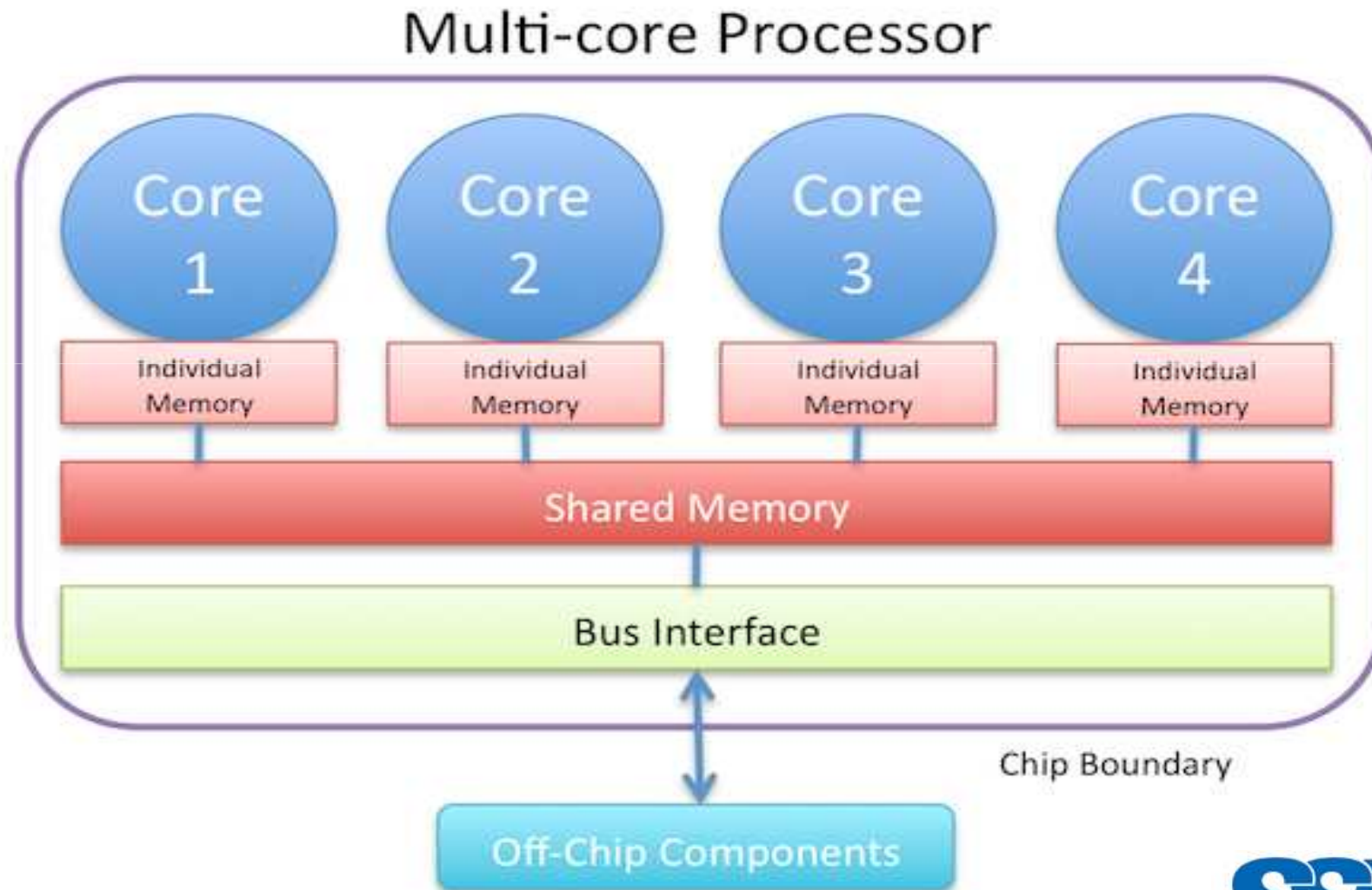
- Multi-core is a design in which a single physical processor contains the core logic of more than one processor.
- It's a special kind of Multiprocessor.
- All processors are on the same chip

# Multicore Architectures...

- Multicore processors are MIMD
- Different cores executes different threads ( Multiple Instructions) ,operates on different parts of memory( Multiple Data)
- Multicore is a Shared Memory Multiprocessors. All cores share the same memory.



# Multicore Architectures...



# Multicore Architectures...

- contain two or more distinct cores in the same physical package
- each core has its own execution pipeline
- each core has the resources required to run without blocking resources needed by the other software threads.
- core design enables two or more cores to run at somewhat slower speeds and at much lower temperatures



# Multicore Architectures

- combined throughput of these cores delivers processing power greater than the maximum available today on single-core processors and at a much lower level of power consumption
- Ex: 16 core MIT RAW processor operates at 425 MHz can perform 100 time the number of operations per second than Intel Pentium-3 with 600MHz.



# Advantages



- Occupies less space on PCB
- Higher throughput
- Consume less power
- Cache coherency can be greatly improved
- Performs more operations/sec with less frequency

# Disadvantages



- Maximizing the utilization of the computing resources provided by multi-core processors requires adjustments both to the operating system (OS) support and to existing application software
- They are more difficult to manage thermally than lower-density single-chip designs

# Multicore applications

- Data base servers
- Web servers
- Compilers
- Multimedia Applications
- Scientific Applications
- General applications with TLP as opposed to ILP
- Downloading s/w while running Anti virus s/w
- Editing photo while recording TV show.

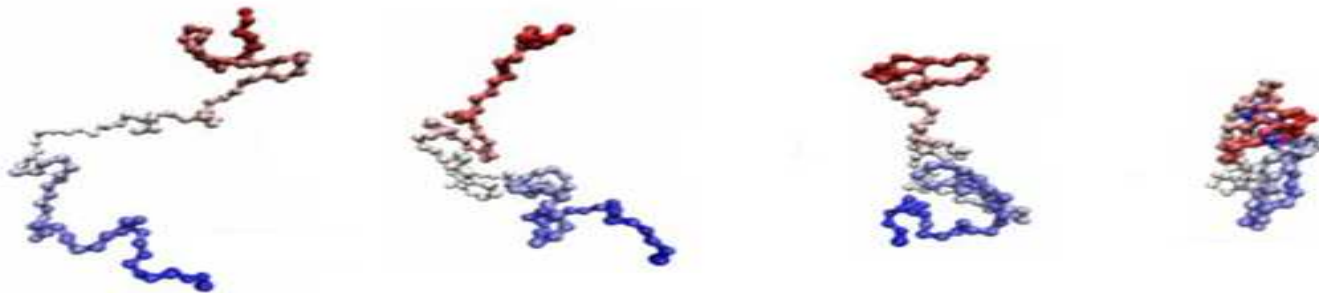
# Climate modeling

- To understand climate change:
  - we need far more accurate computer models
  - models that include interactions between the atmosphere, the oceans, solid land, and the ice caps at the poles.



# Protein folding

- To analyze the protein structures:
  - ability to study configurations of complex molecules such as protein
  - misfolded proteins may be involved in diseases such as Parkinson's, and Alzheimer's etc.





# Drug discovery

- increased computational power can be used in research into new medical treatments.
- devise alternative treatments by careful analysis of the genomes of the individuals for whom the known treatment is ineffective.



# Energy Research

- Increased computational power will make it possible to program much more detailed models of technologies such as wind turbines, solar cells, and batteries.
- may provide the information needed to construct far more efficient clean energy sources



# Data analysis

- The quantity of data stored worldwide doubles every two years.
- The vast majority of it is largely useless unless it's analyzed
- Ex: knowing the sequence of nucleotides in human DNA is, by itself, of little use.
- Understanding how this sequence affects development and how it can cause disease requires extensive analysis.



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