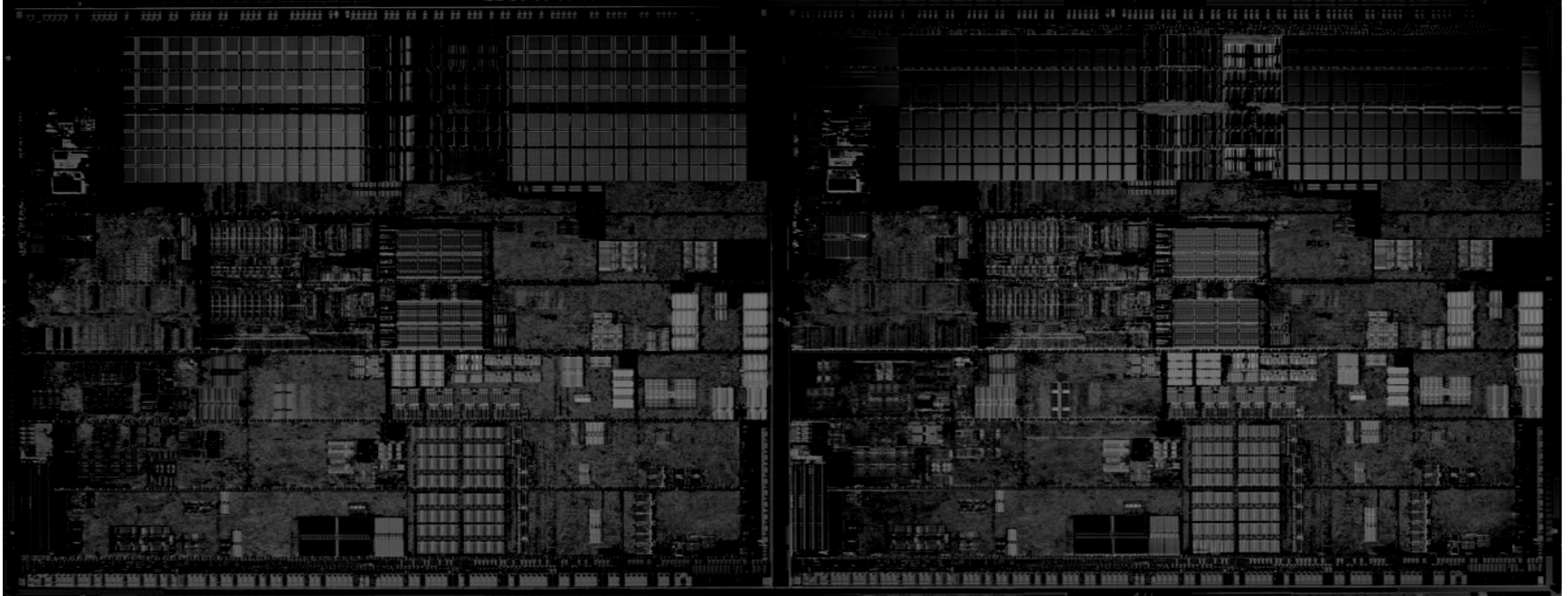


HETEROGENEOUS MULTICORE PROCESSORS



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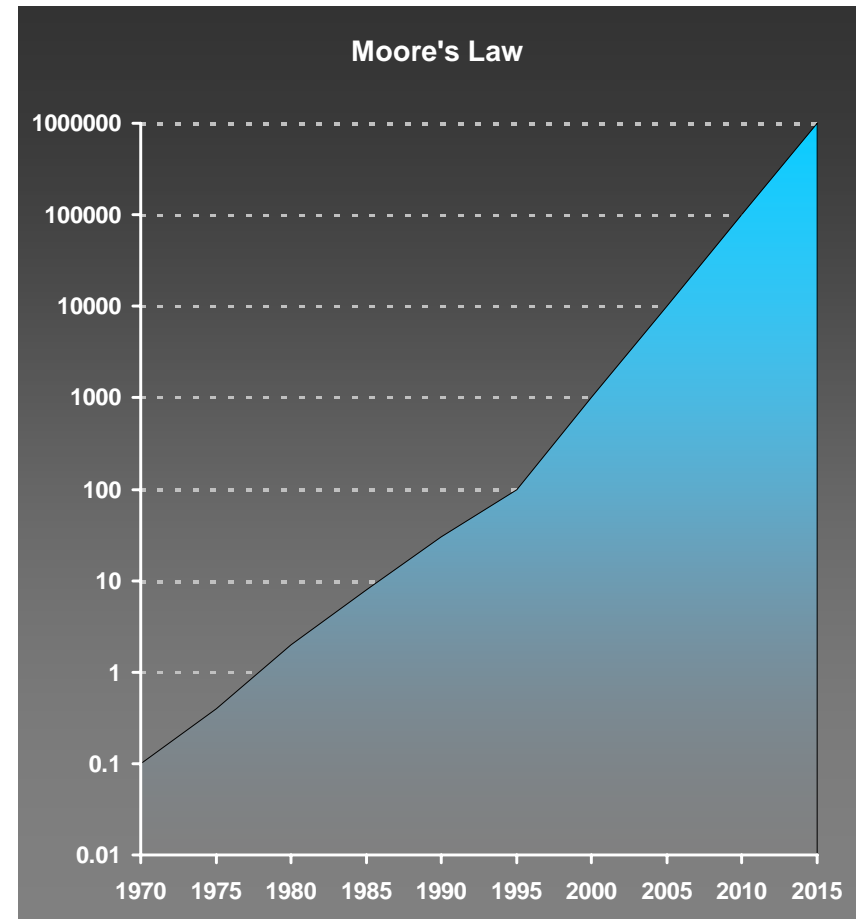
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INTRODUCTION: BASIC CONCEPTS

- Frequency
 - Number of cycles per second.
 - Higher frequency generally means higher performance.
- Power
 - Amount of work done per second.
 - Proportional to frequency.
 - Depends on the number of transistors.
- Moore's Law
 - Performance of processors doubles every 18 months.

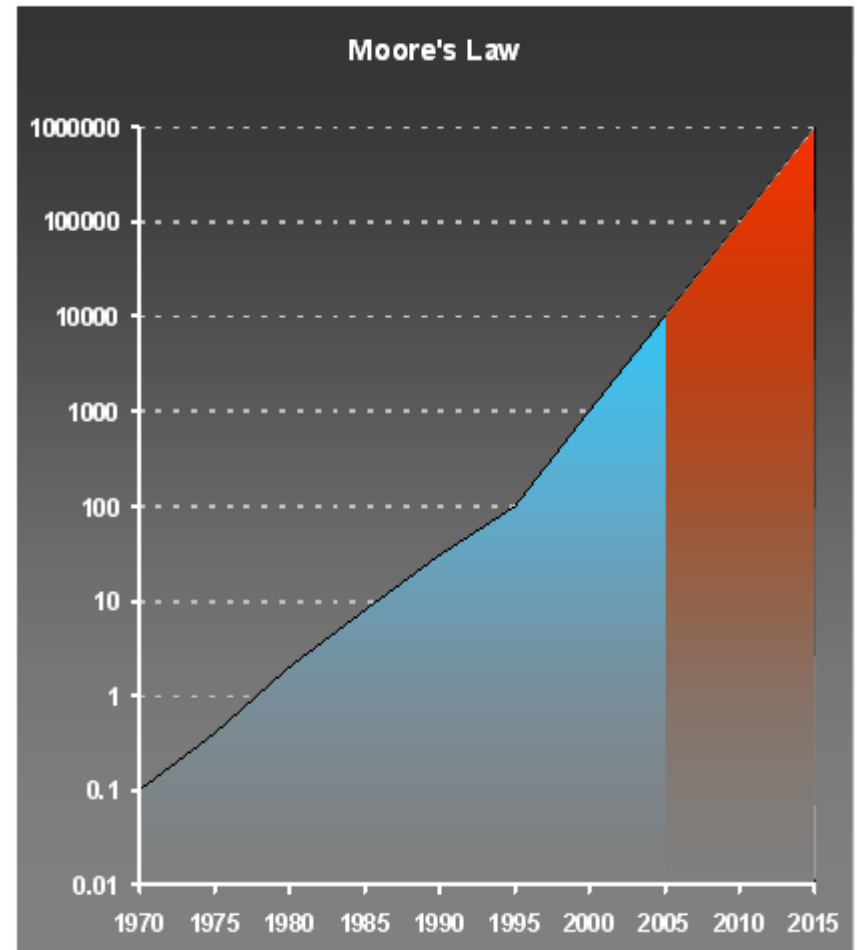
INTRODUCTION: ADVANCED CONCEPTS

- More on Moore.
 - Some time in the next several years we get to some finite limits” – Gordon Moore, 1997
 - Theoretical limit to be reached by 2017.
- Current Options
 - 65nm > Increased costs
 - Utilize parallelism
 - Hyperthreading
 - Dual Core Processors



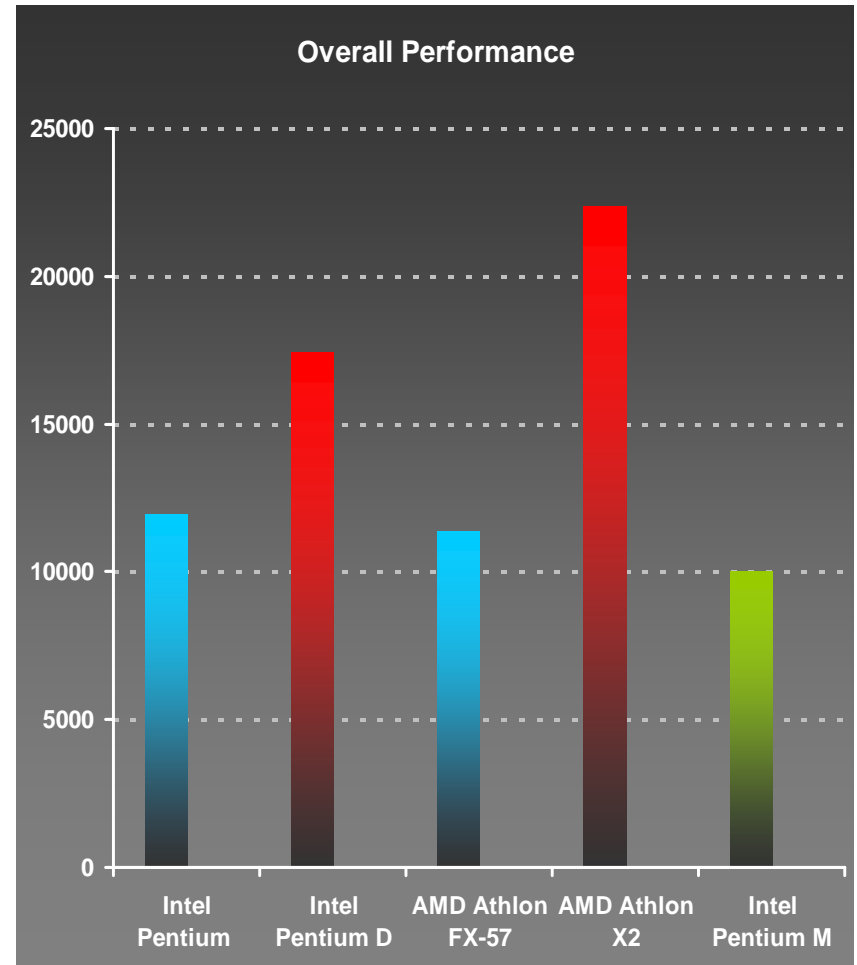
INTRODUCTION: ADVANCED CONCEPTS

- Future Options
 - Multicore
 - Heterogeneous
 - Programmable
 - System on Chip



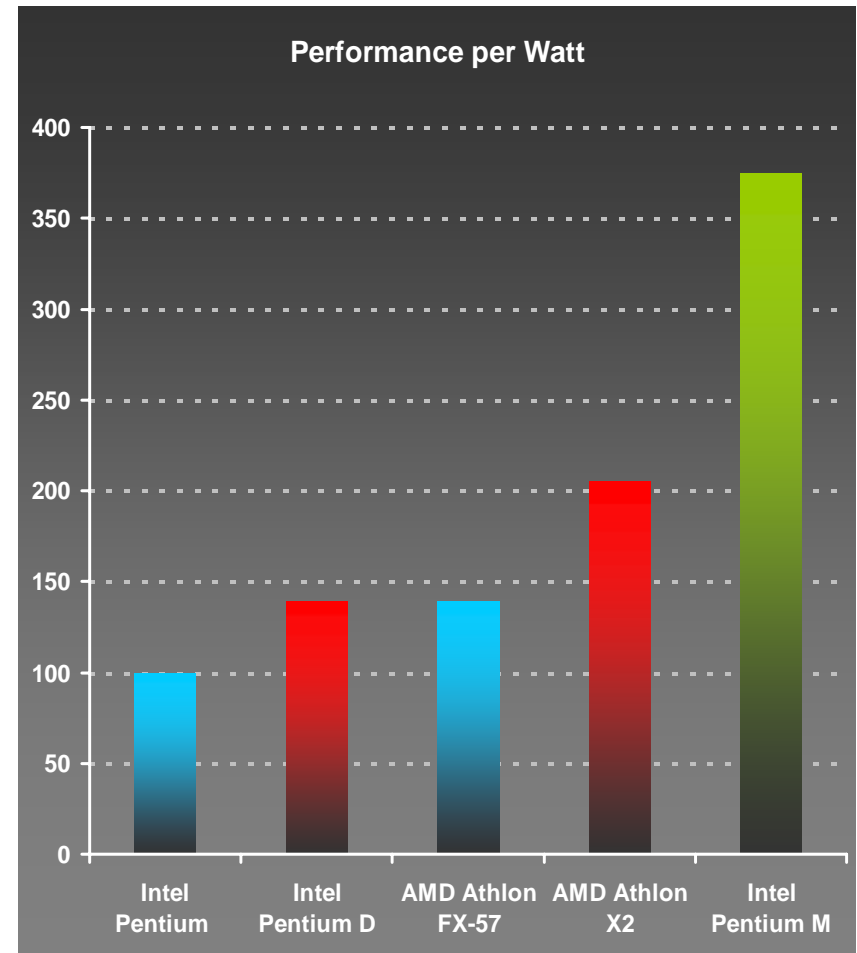
PERFORMANCE COMPARISON

- Dual Core is roughly 30% faster than single core.
- Operates at a lower frequency.
- Much lower power consumption per core.



PERFORMANCE PER WATT COMPARISON

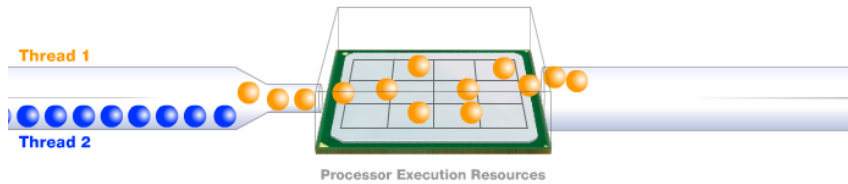
- Performance advantages of high end are marginal
- Dual Core outperforms Single Core
- Mobile architectures are still more efficient



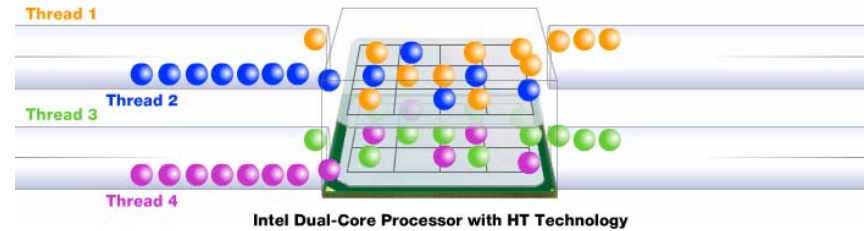
PRINCIPLES OF OPERATION

Processor without Hyper-Threading Technology

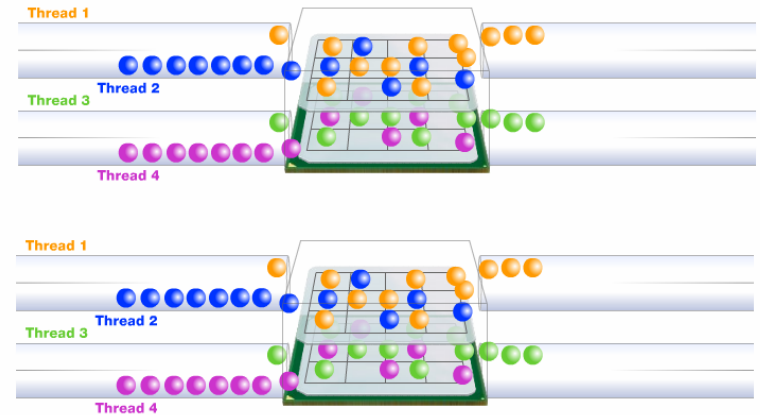
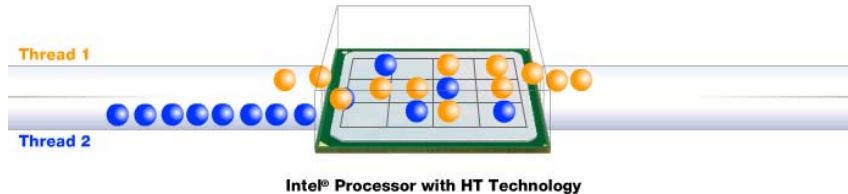
A single-threaded processor can run only one software thread, or instruction sequence, at a time in a serial manner.



An Intel dual-core processor with HT Technology enables execution on four threads in parallel.



An Intel processor with HT Technology can execute two software threads in an increasingly parallel manner, utilizing previously unused resources.

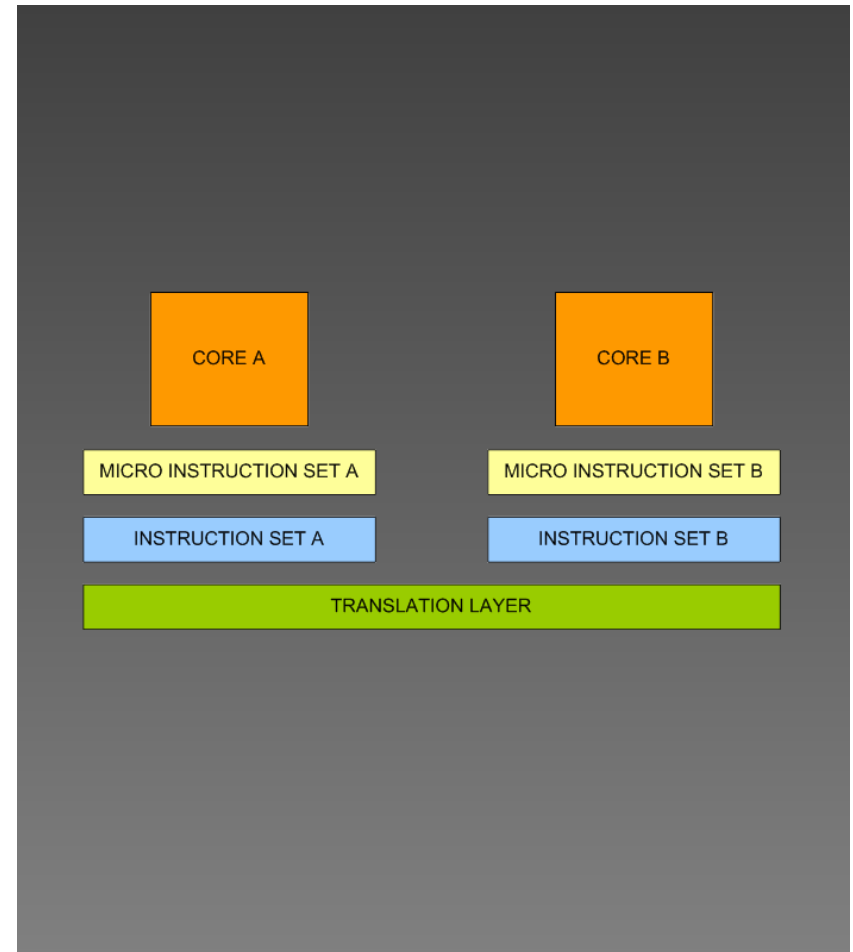


ADVANTAGES OF MULTICORE: COMPATIBILITY

- Heterogeneous cores can provide different levels of compatibility between the processors.
- More efficient designs at no expense in backward compatibility.
- Slower cores backward compatible cores can be combined with faster ones.
- Cores with different instruction sets can be combined through programmable layer that translates one into another.

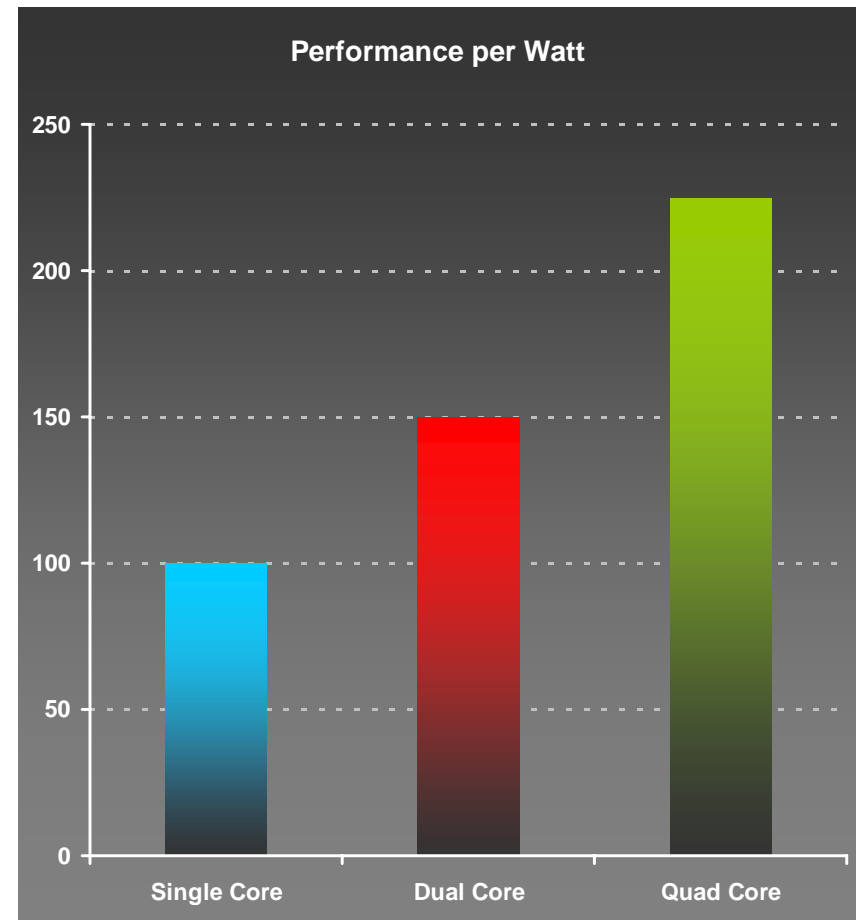
ADVANTAGES OF MULTICORE: COMPATIBILITY

- RISC -
 - Reduced Instruction Set Computer
- Micro Instruction Set –
 - Breaks RISC Instructions further into smaller pieces for faster processing
- Translation Layer –
 - Translates One Instruction Set into another.



ADVANTAGES OF MULTICORE: EFFICIENCY

- Decreased Power Consumption
 - Low power processors are usually more efficient.
 - Heterogeneous cores can provide balance between performance and power consumption.
- Application Specific Instruction Sets
 - Higher efficiency
 - Higher performance

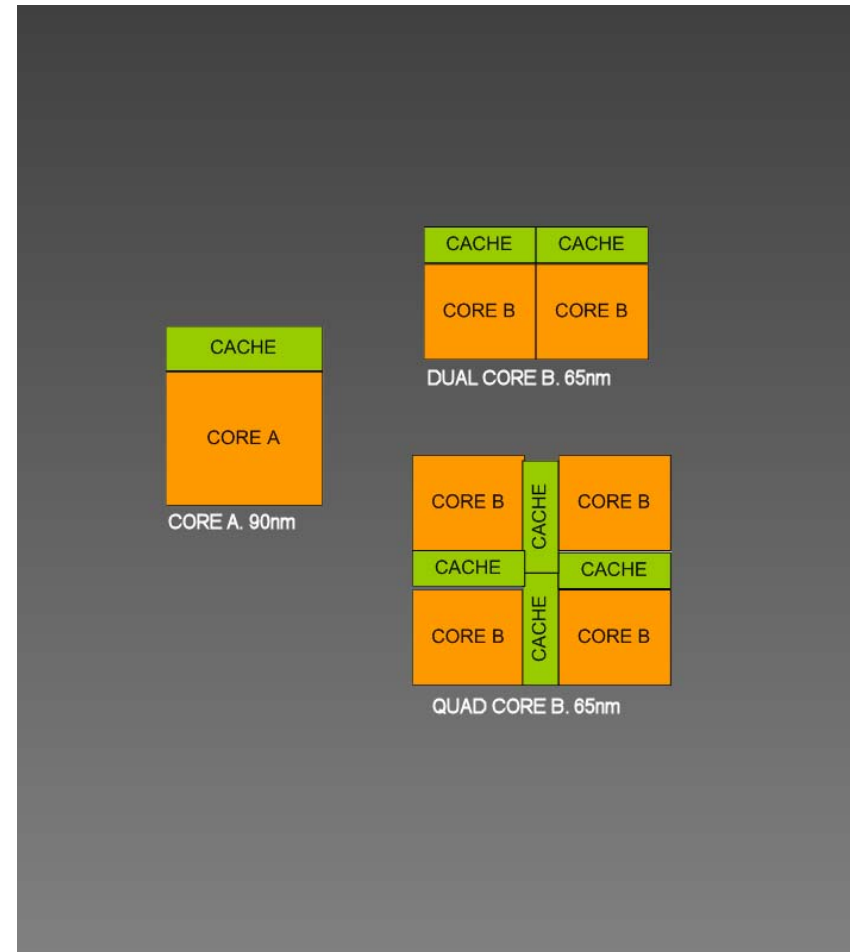


ADVANTAGES OF MULTICORE: FUNCTIONALITY

- Application Specific Instruction Sets
 - High performance cores
 - Specialized Instruction Set for each core.
 - Tailored for a specific application.
 - High flexibility through software programmability.
 - High performance at low power consumption.
 - Multi-Media Applications.
- Core Synthesis
 - Combination of high performance and energy efficient cores.
 - Select cores work for a specific application.
 - Need a sophisticated communications bus.

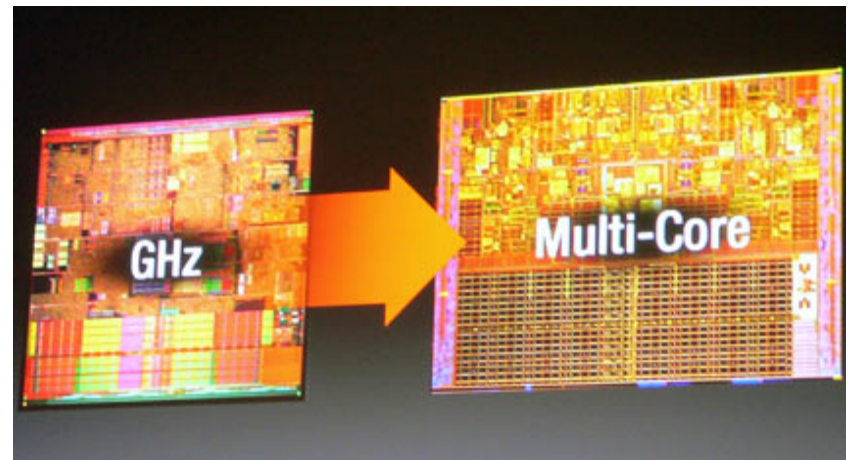
FEASIBILITY

- 90nm
 - Current manufacturing process
 - Good enough for dual core applications
- 65nm
 - Takes over 90nm in 2006
 - High initial costs
 - Lower cost per chip
 - 50% Smaller area
 - More cores can be fit together on a die.



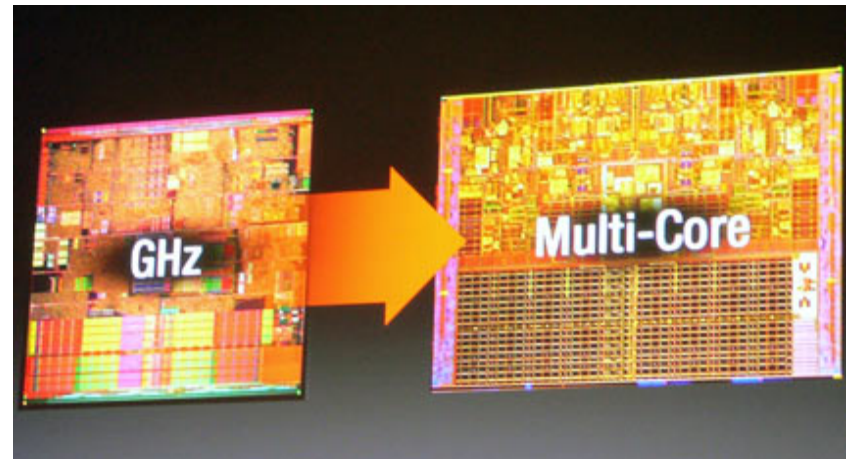
WHY MULTICORE?

- Performance Advantages
 - 10X Faster
 - Can be tailored for specific application
 - Truly parallel execution
 - High performance mobile solutions



WHY MULTICORE?

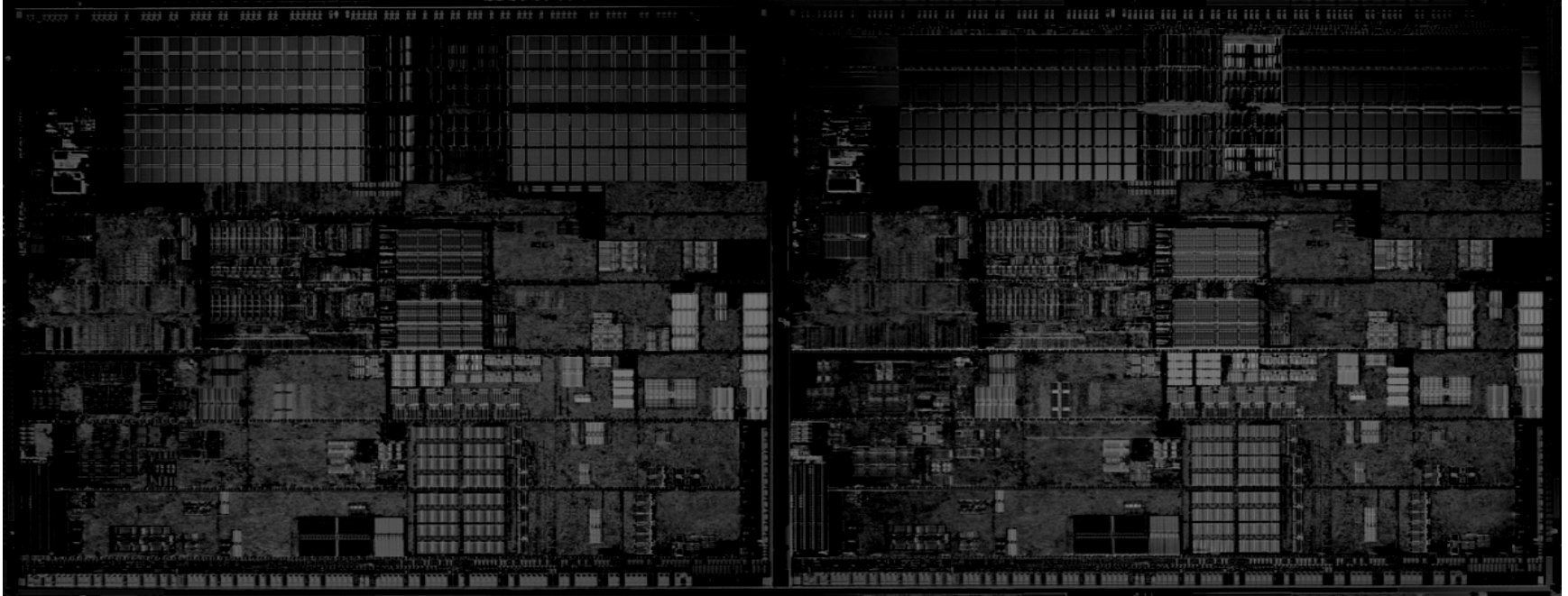
- Power Advantages
 - 10X lower power consumption
 - Enables thinner faster and lighter laptops
 - Handtops – power of a computer on your palm
 - 24 hour battery life
 - Lower heat dissipation through decreased frequency.



REFERENCES

- Intel Corporation: www.intel.com
- AMD Corporation: www.amd.com
- Tom's Hardware Guide: www.tomshardware.com
- Computer Magazine: www.computer.org
- Specific References Available if Requested

QUESTIONS?



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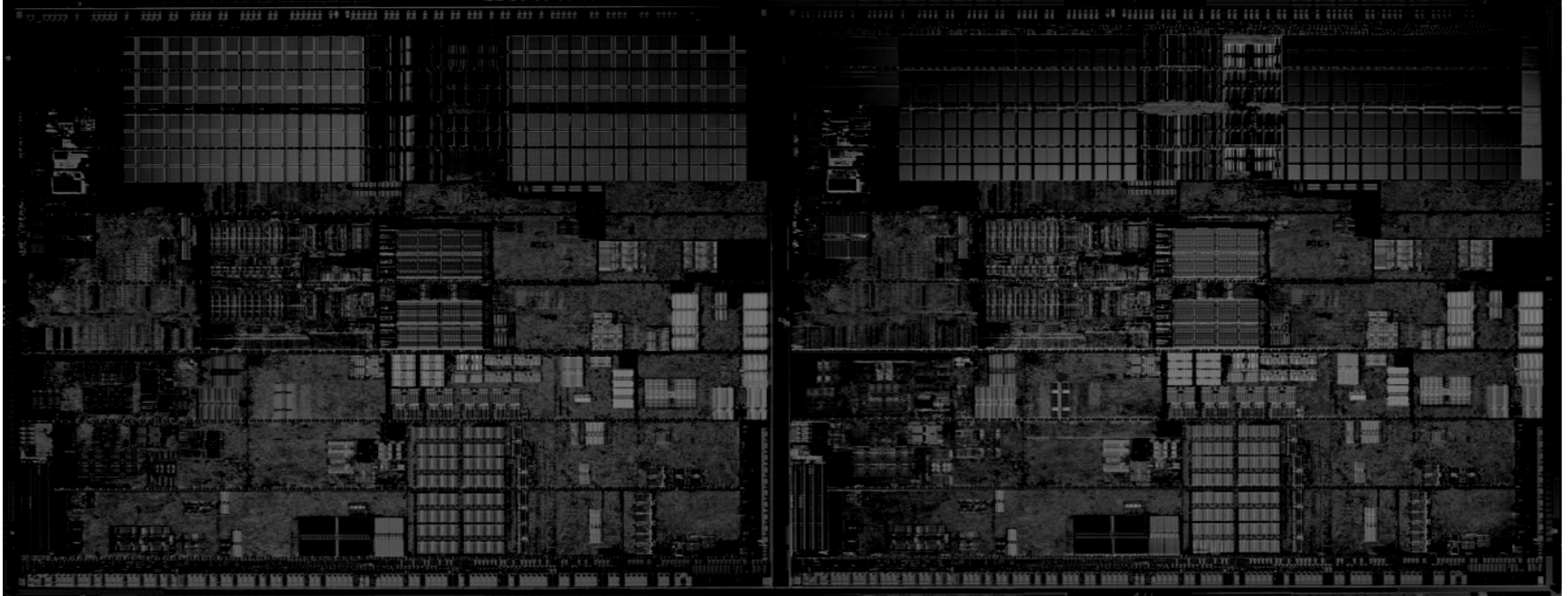


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THANK YOU.



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